Televés

MTD 120

Ref. 4202 (Color)

Ref. 4207 (B/N)

BER

(Bit Error Rate)

TV & SAT Level Meter

User´s manual

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SAFETY NOTES

Read the instruction manual before using the equipment, mainly " SAFETY RULES " paragraph.

The symbol on the equipment means "SEE INSTRUCTION MANUAL".
In this manual may also appear as a Caution or Warning symbol.

Warning and Caution statements may appear in this manual to avoid injury hazard or damage to this product or other property.

1.- GENERAL

1.1.- Description

The result of uniting long experience in the design of TV signal analysers with the latest in technological progress, the MTD 120 brings together the functions installers seek most, all in one **small**, **light-weight**, portable instrument.

The range of frequencies covered, from 5 to 862 MHz and from 920 to 2150 MHz, makes **MTD 120** an excellent instrument for **FM radio**, **terrestrial TV**, **cable TV** (**CATV**, 'Community Antenna Television', where the subband tuning margin, from 5 to 45 MHz, enables the user to carry out tests on the return channel), **satellite TV**, **MMDS microwave links**, **VSAT** ('Very Small Aperture Terminal') **systems**, **digital TV** and **intermediate frequency** analysis (**38.9 MHz**). Furthermore, its high resolution frequency, **50 kHz**, makes FM measurements much easier.

The **MTD 120 includes the main TV standards**: **M, N, B, G, I, D, K** and **L,** adopting, apart from the characteristic parameters of the standard, the correcting automatic system to obtain in all the cases an accurate measuring of the input signal level. It admits any TV system (**PAL**, **SECAM** and **NTSC**) and allows the user to work directly with **digital TV** signals for which it provides directly the measuring of power and carrier-to-noise ratio (**C/N**). Being a multistandard instrument, it can be efficiently used in any country of the world. Its accuracy and reliability meet the needs of the most demanding users.

A powerful microprocessor automatically handles a large part of the operations necessary to optimise the process of measurement; for example, continuous frequency synthesis, measurement correction, the appropriate selection of the attenuators and the automatic cut-off after the device has been inactive for a certain period of time.

The signal level measured is indicated numerically in absolute values and, optionally, on an analogue bar shown superimposed on the monitor image, that facilitates the detection of the maximum level. Moreover, in the LV sound mode, the loudspeaker emits a tone whose frequency depends on the level of the signal received, which is very useful when installing antennas. It is also possible to display on screen the line synchronism pulse like on an oscilloscope screen.

The **Spectrum Analyser** mode enables all the signals on a band to be viewed on the monitor at the same time to measure analogue channels level, C/N ratio referenced to a noise frequency defined by the user and digital channels power using an integration method. The bandwidth of the measuring filter can be modified to improve frequency resolution. This is an indispensable feature, as high channel density is present on all transmission systems today. Spectrum display can be varied between full span (the entire band) and 8 MHz terrestrial or 32 MHz satellite. In addition, there are two markers in order to locate and list frequencies, to read signal level and frequency difference, and the level between both.

The selection of sound subcarrier is automatic, depending on the standard, or tunable between 4 and 9 MHz. When decoding TV sound it is possible to choose between the **NARROW** and **WIDE** filter to obtain the best carrier discrimination. It includes a **NICAM** decoder (with BER measurement); the possibility to commute the channel that is delivered to the loudspeaker enables the user to check the sound stereo and dual.

To enhance its convenience of use, it has **99 memories** to store the different measuring configurations: name of the configuration, frequency, TV system, type of measurement, external units powering, units of measurement and sound. Moreover, the **DATALOGGER** function permits the acquisition and storage of up to **9801 measures** (99 configurations x 99 points of measure) that makes it much easier to test systems in which a large number of measurements have to be made, and enables further processing of all the information acquired.

Also, the level meter incorporates the **teletext** function, a **DiSEqC** command generator and permits to supply different voltages to the external unit (**13 V / 15 V / 18 V / 24 V** terrestrial TV, and **13 V / 15 V / 18 V / 13 V + 22 kHz / 15 V + 22 kHz / 18 V + 22 kHz** satellite TV).

A **SCART** connector has been also included with input/output of audio/video.

The **MTD 120** is powered by rechargeable batteries or connected to the mains through the supplied external DC power adapter.

It also incorporates a **RS-232C** interface which enables the user to connect the instrument to a PC for data recording, remote-control of the instrument and to a printer in order to print out the measurements.

(*) DiSEqC™ is a trademark of EUTELSAT.

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1.2.- Specifications

TUNING	Digital frequency synthesis. Continuous tuning from 5 to 862 MHz and from 920 to 2150 MHz
Tuning modes	Frequency, Channel or Memory. Channel plan configurable on demand
Resolution	50 kHz
Automatic search	Threshold level selectable
Memory	99 positions for measurement configurations
RF INPUT	
Frequency range	
QAM signals	47 MHz to 862 MHz
QPSK signals	950 MHz to 2150 MHz
COFDM signals	470 MHz to 862 MHz
Level range	
QAM signals	45 dBµV to 110 dBµV
QPSK signals	44 dBµV to 99 dBµV
COFDM signals	45 dBµV to 100 dBµV
Impedance	75 Ω
Connector	Universal, with BNC or F adapter
Maximum signal	130 dBµV
Maximum input voltage	
DC to 100 Hz	50 V rms (powered by the power adapter) 30 V rms (not powered by the power adapter)
5 MHz to 2150 MHz	130 dBµV
LEVEL MEASUREMENT	
Measurement range	
Terrestrial TV & FM bands	20 dBµV to 130 dBµV (10 µV to 3.16 V)
Satellite TV band	30 dBµV to 120 dBµV (31.6 µV to 1 V)
Reading	Auto-range, reading is displayed on an OSD window
Digital	Absolute value calibrated in dBµV, dBmV or dBm
Analogue	Relative value through an analogue bar on the screen
Measurement bandwidth	230 kHz (Terrestrial band) • 4 MHz (Satellite band) (maximum band ripple 1 dB).
Audible indicator	LV audio. A tone with pitch proportional to signal strength.
Accuracy	
Sub-band	± 2.5 dB (50-120 dBµV, 5-45 MHz)(22ºC ± 5ºC)
Terrestrial bands	±1.5 dB (30-120 dBµV, 48,25-861 MHz)(22ºC±5ºC)
Satellite band	±1.5 dB (40-100 dBµV, 920-2050 MHz)(22ºC ± 5ºC)
Overrange indication	↓, ↑
BER MEASUREMENT	
QAM signals	
Measurement	BER before FEC (Forward Error Correction). Number of non correctable packets received in the measurement time.
Reading	Numerical and level bar.
QPSK signals	
Measurement	BER before Viterbi BER after Viterbi Number of non correctable packets received in the measurement time.
Reading	Numerical and level bar.
COFDM signals	
Measurement	BER after Viterbi CSI (Channel Status Information). Qualitative measurement about channel quality. Readout between 0 and 100%, the 0 % value corresponds to maximum quality. Number of wrong packets received in the measurement time.
Reading	Numerical and level bar.

DCI FUNCTION	DVB Channel Identifier. It provides information about the channel we are making the measurement.
QAM SIGNAL PARAMETERS	
Demodulation	16 / 32 / 64 / 128 / 256 QAM
Symbol rate	1000 to 7000 kbauds
Symbol Rate acquisition range	± 240 ppm
Carrier frequency offset	± 0,08 x Symbol rate
Nyquist filter roll-off(α)	0,15
Spectral inversion	Selectable: On, Off
Equivalent noise degradation	< 1,5 dB
QPSK SIGNAL PARAMETERS	
IF bandwidth	55 MHz
Symbol rate	23000 to 30000 kbauds
	4000 to 30000 kbauds for channel spacing frequency ≥ 29.5 MHz
Symbol Rate acquisition range	± 70 ppm
Carrier frequency offset	± 0,1 x Symbol rate
Nyquist filter roll-off (α)	0,35
Code rate	1/2, 2/3, 3/4, 4/5, 5/6, 6/7, 7/8, 8/9 and Auto.
Spectral inversion	Selectable: On, Off and Auto except for the following values of Code Rate: 4/5, 5/6, 6/7 and 8/9.
Equivalent noise degradation	< 1 dB
COFDM SIGNAL PARAMETERS	
Carriers	2k / 8k (user definable)
Guard Interval	1/4, 1/8, 1/16, 1/32 (user definable)
Code Rate	1/2, 2/3, 3/4, 5/6, 7/8
Modulation	QPSK, 16QAM, 64QAM
Spectral inversion	On/off
Hierarchy	
FEC	Reed-Solomon (204,188) and Viterbi
MEASUREMENTS IN TV MODE	
Terrestrial bands	
Analogue channels	Level, Video-Audio ratio and Carrier-Noise ratio (Auto and Referenced).
Digital channels	Channel power (Auto) and Carrier-Noise ratio (Auto and Referenced).
Satellite band	
Analogue channels	Level and Carrier-Noise ratio (Auto and Referenced)
Digital channels	Channel power (Auto) and Carrier-Noise ratio (Auto and Referenced).
DATA LOGGER function	Automatic acquisition of up to 9801 measurements
SPECTRUM ANALYSER MODE	
Satellite band	30 dBµV to 120 dBµV (31.6 µV to 1 V)
Terrestrial bands	20 dBµV to 130 dBµV (10 µV to 3.16 V)
Measurement bandwidth	
Terrestrial	230 kHz, 1 MHz selectable
Satellite	230 kHz, 4 MHz selectable
Span	
Terrestrial	Full span (full band), 500, 200, 100, 50, 32, 16, 8 MHz selectable.
Satellite	Full span (full band), 500, 200, 100, 50, 32 MHz selectable.
Markers	2 with level, frequency, level difference and frequency difference indications.
Measurements	
Terrestrial bands	
Analogue channels	Level and Carrier-Noise ratio (Referenced)
Digital channels	Channel power (Integration method) and Carrier-Noise ratio (Referenced).
Satellite band	
Analogue channels	Level and Carrier-Noise rate (Referenced)
Digital channels	Channel power (Integration method) and Carrier-Noise ratio (Referenced).

MONITOR DISPLAY	
Monitor	LCD colour 4 inches (ref. 4202)
	Black & White 4 1/2 inches (ref. 4207)
Colour system	PAL, SECAM and NTSC
TV standard	M, N, B, G, I, D, K and L
Synchronism and Burst	Graphic representation over the picture
Spectrum mode	Variable span and reference level
Sensibility	40 dBµV for correct synchronism
Synchronism 50/60 Hz	Automatic selection according to the system
VIDEO SIGNAL	
External video input	Scart (automatic)
Sensibility	1 Vpp (75) positive video
Video output	Scart (75)
SOUND	
Input	Scart
Outputs	Built in speaker, Scart
Demodulation	AM, FM, TV and NICAM, selectable
De-emphasis	50 µs
Subcarrier	Digital frequency synthesis
Variable	From 4 to 9 MHz, 10 kHz resolution
Fixed	
Terrestrial	According to the active standard: 4.50 - 5.50 - 5.80 -6.00 - 6.50 - 6.65 - 5.74 - AM - FM - LV - OFF.
Satellite	6.65 - 5.80 - 6.50 - 7.02 - LV - OFF
TELETEXT	Decodes at 1.5 level
RS-232C INTERFACE	
EXTERNAL UNITS POWER SUPPLY	Through the RF input connector
Terrestrial	External or 13/15/18 V
Satellite	External or 13/15/18 V
22 kHz signal	Selectable
Voltage	0.6 V ± 0.2 V
Frequency	22 kHz ± 4 kHz
Maximum power	5 W
DiSEqC GENERATOR (*)	According to DiSEqC 1.2 standard
POWER SUPPLY	
Internal	
Batteries	2 x 6 V 3.3 Ah lead acid batteries
Autonomy	> 1 hour non stop
Recharging time	12 h starting from a complete discharge
External	
Voltage	12 V
Consumption	42 W
Auto power off	After 15 minutes without operating on any control. Deactivable.
OPERATING ENVIRONMENTAL CONDITIONS	
Altitude	Up to 2000 m
Temperature range	From 5 to 40 º C
Max. relative humidity	80 % (up to 31ºC), decreasing lineally up to 50% at 40º C.

(*) DiSEqC™ is a trademark of EUTELSAT.

MECHANICAL FEATURES

Dimensions	280 (W) x 95 (H) x 250 (D) mm
Weight	5,2 kg

INCLUDED ACCESSORIES

Rechargeable battery 6 V, 3.3 Ah
"F"/F-BNC/F adapter
"F"/F-"DIN"/F adapter
"F"/F-"F"/F adapter
External DC adapter
Carrying bag

NOTE: BER measurement options of QPSK, QAM or COFDM modulated signals vary based on the model of used Measurer.

2.- SAFETY RULES

* Use this equipment connected **only to systems with their negative of measurement connected to ground potential**.
* The external DC adapter is a **Class I** equipment, for safety reasons plug it to a supply line with the corresponding **ground terminal**.
* This equipment can be used in **Overvoltage Category II** installations and **Pollution Degree 2** environments.
* When using some of the following accessories **use only the specified ones** to ensure safety:

  Rechargeable batteries

  External DC adapter
* Observe all **specified ratings** both of supply and measurement.
* Remember that voltages higher than **60 V DC** or **30 V AC rms** are dangerous.
* Use this instrument under the **specified environmental conditions**.
* **The user is only authorized to** carry out the following maintenance operations:

  Batteries replacement

  On the Maintenance paragraph the proper instructions are given.

  Any other change on the equipment should be carried out by qualified personnel.
* When using the power adaptor, the **negative of measurement** is at ground potential.
* **Do not obstruct the ventilation system** of the instrument.
* Use for the signal inputs/outputs, specially when working with high levels, appropriate low radiation cables.
* Follow the **cleaning instructions** described in the Maintenance paragraph.

* Symbols related with safety:

DIRECT CURRENT

ALTERNATING CURRENT

DIRECT AND ALTERNATING

GROUND TERMINAL

PROTECTIVE CONDUCTOR

FRAME TERMINAL

EQUIPOTENTIALITY

CAUTION (Risk of electric shock)

ON (Supply)

DOUBLE INSULATION (Class II Protection)

OFF (Supply)

FUSE

CAUTION REFER TO MANUAL

3.- INSTALLATION

3.1.- Power Supply

The **MTD 120** is a portable instrument powered by two 6 V - 3.3 Ah lead acid batteries. There is also an external DC adapter provided for mains connection and battery charging.

3.1.1.- Operation using the External DC Adapter

Connect the external DC adapter to **EXT. SUPPLY** [38] on the **MTD 120** side panel. Connect the DC adapter to the mains. Then, press the **MTD 120** on/off key ⏻ [2] The level meter is now in operation and the batteries are slowly charged. When the instrument is connected to the mains, the **CHARGER** indicator [7] remains lit.

3.1.2.- Operation using Batteries

For the device to operate on the battery, disconnect the power cable and press the on/off key ⏻ [2]. The fully charged battery can power the equipment for more than 1 hour non-stop.

If batteries are very weak, the battery cut-off circuit will prevent the device from functioning at the same time the beeper will be heard. In such a situation batteries must be recharged immediately.

Before taking any measurements, you have to check the charge state of the batteries by checking the battery charge level indicator **BATTERY OK** [8] on the front panel, or **Battery & Lnb** function on the TV mode functions menu (see section '4.9.2.3 Batteries and External Units Power Supply').

The **BATTERY OK** [8] led indicates the battery charge state. For battery charge levels close to 100% and if the unit is powered by the external power adapter, it remains lit. For battery levels between 100% and low battery it starts to flicker, gradually fading as the charge level decreases. On reaching Low Battery, it ceases to light up at all. When the instrument indicates a Low Battery (the led does not light up) the batteries must be charged immediately. When the low battery level is reached, the monitor momentarily displays the message VERY LOW BATTERY and the beeper sounds.

3.1.2.1.- Battery Charging

To fully charge the batteries, connect the instrument to the external DC adapter **without pressing** the on/off key ⏻ [2]. The length of time it takes to recharge it depends on the condition of the battery. If they are very low the recharging period is about 12 hours. The **CHARGER** [7] indicator should remain lit.

IMPORTANT

If batteries are completely discharged, it is advisable to recharge them for a period of one hour before putting the instrument into operation again. In these circumstances it is not recommended to power external units at the same time batteries are recharged.

IMPORTANT

The lead acid batteries of the instrument must be kept fully charged during periods when it is not in use. To ensure the best results, the batteries must always be fully charged. If the equipment is in storage or is used only occasionally for a long period of time, it is ABSOLUTELY NECESSARY to check the full-charge functions periodically (every six months, for example), and to compensate for the self-discharging effect of the batteries. The rate at which a fully charged battery self-discharges depends on the temperature. For example, at an ambient temperature of 20º C, the battery suffers a 50% loss after 16 months, and at 40º C it loses the same charge in only 5 months. If the battery remains very weak for a period of several days, it cannot be recharged since the plates are sulphated and must be replaced.

3.2.- Installation and Start-up

The **MTD 120** level meter is designed for use as a portable device.

When the ⏻ [2] key is pressed, the instrument is in the automatic power-off mode; that is, the device is automatically disconnected fifteen minutes after the last time a key has been pressed. When turning on the unit, automatic power-off mode may be deactivated by holding down the ⏻ [2] key until you hear two acoustic indications, later "**MANUAL POWER OFF**" message will appear on the lower side of the monitor. When the device is operating, it is also possible to select the manual power-off mode by means of the **Manual power** function of the TV functions menu.

4.- OPERATING INSTRUCTIONS

4.1.- Description of the Controls and Elements

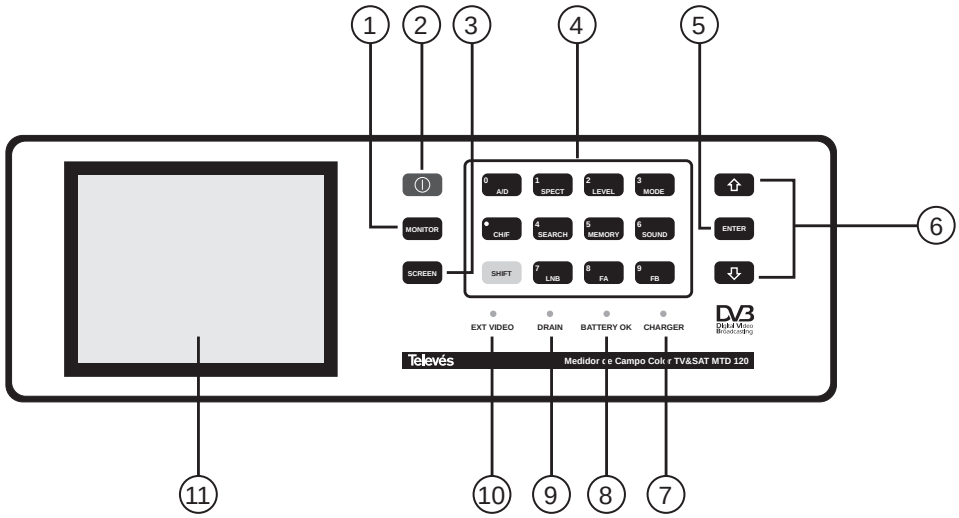

Figure 1.- Front panel.

[1] ⏻

On / Off key. This turns on the instrument, and the user can select either manual or automatic power-off.

[2] MONITOR.

Enables the measurement information displayed on-screen in TV mode (level measurement) to be selected.

[3] SCREEN.

Activation of **VOLUME**, **CONTRAST**, **BRIGHTNESS**, **SATURATION** (only ref. 4202) and **HUE** (this last only for NTSC colour system and ref. 4202) control menus.

[4] MAIN KEYBOARD

12 keys to select functions and entering numeric data.

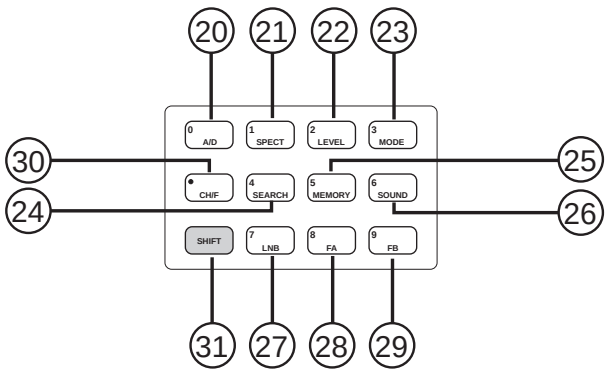

Figure 2.- Main keyboard.

[5] ENTER.

Validation of the different options.

In **TV mode**, press the **ENTER** [5] key to display a menu containing different functions, some are dependent on the band and the standard:

Band switching Permits to change from terrestrial (5-862 MHz) to satellite band (920-2150 MHz) and vice versa.

System & Standard	Selects the colour system (**PAL**, **SECAM** or **NTSC**) and the TV standard (**B/G**, **D/K**, **I**, **L**, **M**, **N** or **Digital**).
Battery & Lnb	Displays battery voltage and external units power supply voltage and current (**V Lnb** and **I Lnb**).
Data logger	Permits to acquire and to store up to 9801 measurements automatically.
Clock	Displays time and date, and allows them to be modified.
Input Video	Enables Scart commutation signals to be activated, deactivated or set to automatic/subordinate mode.
Channel set	Selects active channels table.
Units	Selects the measuring units: dBµV, dBmV or dBm.
Manual power	Sets power-off as Manual or Automatic.
C/N setup	Defines the C/N measuring method between Auto or Referenced.
Reference noise	(Only in C/N Reference noise mode). Defines the frequency where measure the noise level.
Channel BW	(Satellite band or digital channels). Defines channel bandwidth. Indispensable for measuring digital channels and satellite band channel C/N.
Lnb local osc	(Only satellite band). It defines the frequency of the local oscillator (L.O.) of the LNB.
Video polarity	(Only satellite band, analogue channels). This selects the polarisation of the video carrier.
Nicam channel	(Only analogue channels). This selects the NICAM sound channel that is sent to the loudspeaker.
Search level	(Only analogue channels). Selects the threshold level of the automatic station search function.
Teletext	(Only analogue channels). Sets teletext information.
DiSEqC	(Only satellite channels). Defines a sequence of DiSEqC commands and permits to send them.
Beep	Activates (ON) / deactivates (OFF) the beeper.
Equipment info.	Displays information on the instrument: serial number, version of control software, options installed, etc.
Exit	Exits from the function menu.

In **Spectrum Analyser** mode the menu displays the following functions:

Band switching	Permits to switch from terrestrial (5-862 MHz) to satellite band (920-2150 MHz) and vice versa.
Span	Defines the frequency range displayed between **Full** (the entire band), **500 MHz, 200 MHz, 100 MHz, 50 MHz, 32 MHz, 16 MHz** and **8 MHz** (the latter two only for terrestrial bands).
Reference level	Defines the reference level between **70** and **130 dBµV** in **10 dB** steps.
Dual marker	(Only analogue channels, level measurement mode and single marker mode). Enables dual markers to be shown on the displayed spectrum.
Marker A	(Only in dual marker mode). Selects marker **A** as the active marker (tuneable).
Marker B	(Only in dual marker mode). Selects marker **B** as the active marker (tuneable).
Single marker	(Only in dual marker mode). Activates the single marker on the displayed spectrum.
Sweep	Selects sweep speed in spectrum mode between **Fast** (fast sweep, low accuracy) and **High Resolution** (slow sweep, high accuracy).
Reference noise	(Only in C/N measurements). Permits to define the frequency where noise level will be measured (see Carrier function).
Channel bandwidth	(Only in Channel Power measurements). Permits to define channel bandwidth (see Marker function).
Marker	(Only when measuring Channel power and after defining the Channel bandwidth). Permits to change the tuning frequency by means of the ⇧ ⇩ keys.
Carrier	(Only when measuring C/N Referenced and after defining the Reference noise). Permits to change the tuning frequency by means of the ⇧ ⇩ keys.
Measure bandwidth	Selects the bandwidth of the spectrum measuring filter from among: Terrestrial channels: **230 kHz** or **1 MHz**. Satellite channels: **230 kHz** or **4 MHz**.
Channel set	Selects active channels table.
Battery & Lnb	Displays battery voltage and external units power supply voltage and current (V Lnb and I Lnb).
Exit	Exits from the function menu.

[6] ⇧ ⇩

Tuning control and moving between the various on-screen menus.

Tuning purposes: when pressing ⇧ key, frequency increases while when pressing ⇩ key, frequency decreases.

To **shift along the on-screen menus**: when pressing ⇧ key, active option moves upwards while when pressing ⇩ key, active option moves downwards.

[7] CHARGER.

External DC adapter operation indicator. When batteries are installed the battery charger is automatically activated.

[8] BATTERY OK.

Battery charge level indicator.

[9] DRAIN.

External units power supply indicator. Lights up when the **MTD 120** supplies a current to the external unit.

[10] EXT VIDEO.

It lights up when an external video signal is present through the SCART connector [39].

[11] Monitor

[20] A/D

Switches between analogue and digital mode.

Key number 0 to enter numeric data.

[21] SPECT.

Enables switching between the TV and the Spectrum Analyser operation mode, and back again.

Key number 1 to enter numeric data.

[22] LEVEL.

Enables the type of measurement to be selected. The types of measurements available depend on the band, the standard, the options included and the operating mode.

Key number 2 to enter numeric data.

[23] MODE

Selects the information displayed on-screen in TV operation mode (LV measurement).

Key number 3 to enter numeric data.

[24] SEARCH

This is the function for automatic station search. Starting at the present frequency or channel, it searches until finds a station with an adequate level. The threshold level (search level) can be defined by means of the TV mode functions menu between 30 and 99 dBµV.

Key number 4 to enter numeric data.

[25] MEMORY

This key enables the measurement configuration to be stored/recalled. Each configuration has the following information: name assigned to memory, memory number, **Channel** or frequency (**Freq**), TV system (**TV Sys**), measurement mode (**Meas**), external units power supply (**V Lnb**), measurement units (**Units**) and **Sound**. The memory can store up to 99 measurement configurations (numbered from 1 to 99).

Key number 5 to enter numeric data.

[26] SOUND

This selects the type of sound. The options available in each case depend on the band and the standard selected (see section 4.11 Selecting the Sound Mode).

Key number 6 to enter numeric data.

[27] LNB

Enables selecting the power supply to the external units. Available voltages are: **External, 13 V, 15 V** and **18 V** for the terrestrial band and **External, 13 V, 15 V, 18 V, 13 V + 22 kHz, 15 V + 22 kHz** and 1**8 V + 22 kHz** for the satellite band.

Key number 7 to enter numeric data.

[28] FA

Direct access key which can be assigned to any function on any menu.

Key number 8 to enter numeric data.

[29] FB

Direct access key which can be assigned to any function on any menu.

Key number 9 to enter numeric data.

[30] CH/F

Switches tuning mode between channel and frequency. In channel mode the tuning frequency is defined by the active channels table (CCIR, OIRT, ...). See channel-frequency tables in Appendix A.

Decimal point key to enter numeric data.

[31] SHIFT

Enables the desired frequency to be directly tuned using the numeric keyboard. Also acts as a SHIFT key for moving across different fields on some screens.

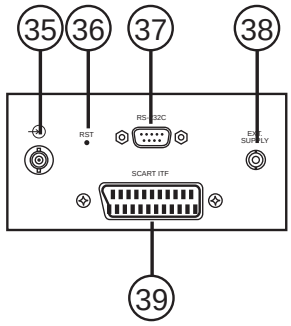

Figure 3.- Side panel connections.

[35] RF ⊖ . RF signal input.

Maximum level 130 dBµV. Universal connector for F/F or F/BNC adapter, with input impedance of 75Ω.

ATTENTION

Note the importance to protect the RF ⊖ [35] input signal with an accessory to block the AC voltages used in CATV cables (needed to feed the amplifiers) and remote mode.

[36] RESET button

Enables the user to restart the instrument if there is any irregularity in its functioning. If it is necessary to reset the instrument, press the reset button with the instrument turned off.

[37] Connector RS-232C

Enables the remote control of the **MTD 120** from a personal computer, as well as data dumping to a printer.

[38] External 12 V power supply input

[39] Scart socket

ENGLISH

4.2.- Adjustment of Volume and Monitor Parameters

Repeatedly pressing key **SCREEN** [3] sequentially activates the **VOLUME**, **CONTRAST**, **BRIGHTNESS**, **SATURATION** and **HUE** (this last only for NTSC colour system) control menus. On activation of a menu for a specific parameter the screen displays a horizontal bar whose length is proportional to the parameter level, to modify this value simply press keys ⇧ ⇩ [6]. To exit the menu and validate the new value press key **ENTER** [5].

4.3.- Selecting the Operation Mode: TV / Spectrum Analyser

The **MTD 120** has two basic operation modes: **TV** and **Spectrum Analyser**. To switch from one operation mode to the other press key **SPECT** [21].

In the **TV operation** mode the demodulated television signal is shown on-screen; this is the default operation mode, various functions can be selected, as shown in the following paragraphs.

In the **Spectrum Analyser** operation mode the screen displays the power spectrum of the active band (terrestrial or satellite). The span, the reference level and the measuring filter bandwidth are variable as will be shown in paragraph '4.10 Spectrum Analyser Operation Mode'.

4.4.- RF Band Selection: 5-862 MHz / 920-2150 MHz

Tuning is continuous between 5 and 862 MHz (terrestrial band) and between 920 and 2150 MHz (satellite band). There are three ways of changing the active band:

1. Press key **ENTER** [5] to accede to the functions menu, if necessary press keys ⇧ ⇩ [6] to select the **Band switching** function and then press key **ENTER** [5] again. The RF band will be switched automatically.
2. Press key **SHIFT** [31] and select a frequency on the new band using the numeric keyboard. The fifth digit and second decimal act as confirmation. For example, if the active band is the 920 to 2150 MHz band and you wish to tune the 49 MHz frequency (belonging to the 5/45 to 862 MHz band), press key **SHIFT** [31] and then enter **49.00** or **0049.0** using the numeric keyboard.
3. Recall a memory with a tuning frequency belonging to the band you wish to access. (See section '4.12 Measurement Configuration Memories').

4.5.- Channel Tuning / Frequency Tuning

Pressing key **CH/F** [30] the **MTD 120** switches from frequency tuning to channel tuning and back again.

In **channel tuning** mode pressing keys ⇧ ⇩ [6] sequentially tunes the channels defined in the active channels table (see the **Channel set** function in the TV mode functions menu, section '4.9.2.7 Selecting the Channels Table'). Pressing key ⇧ frequency increases while pressing key ⇩ frequency decreases.

In **frequency tuning mode** there are two ways of tuning:

1. **Pressing keys** ⇧ ⇩ [6].

   By means of keys ⇧ ⇩ [6] selects the desired frequency (tuning is continuous from 5 to 862 MHz and from 920 to 2150 MHz). When pressing key ⇧ frequency increases while pressing key ⇩ frequency decreases.

2. **Using the keyboard.**

   Press key **SHIFT** [31](the frequency listing will disappear), next enter the frequency value in MHz using the numeric keyboard, the fifth digit and the second decimal act as confirmation. The **MTD 120** will calculate the tuneable frequency closest to the entered value and then display it on-screen.

4.6.- Búsqueda Automática de Emisoras

In the TV mode, by pressing the **SEARCH** [24] key search starts at the present frequency or channel until it finds a transmission with a level higher than the search level. The threshold level is defined by means of the **Search level** function of the TV mode functions menu (see paragraph '4.9.2.15 Search Level'.).

The **Search function** halts the search process when the end of the present band is reached, if it is in frequency mode, or when a key is pressed. In channel mode, the search process is halted when the last channel of the group selected is reached (see Appendix A). The sound is deactivated during the search process.

4.7.- Selecting Analogue / Digital Mode

Measuring the characteristics of a channel depends, in the first place, on the type of modulation: analogue or digital.

Use key **A/D** [20] to switch between analogue and digital channels. When switching to a new modulation, the **MTD 120** activates the last measurement configuration used for that modulation.

4.8.- External Units Power Supply (EXT. SUPPLY)

The **MTD 120** can supply the voltage needed to power the external units (antenna preamplifiers, in the case of terrestrial TV, or LNB, in the case of satellite TV).

Maximum input levels

DC to 100 Hz	**50 V rms (powered by the power adapter)**
	30 V rms (not powered by the power adapter)
5 MHz to 2150 MHz	**130 dBµV**

To select the supply voltage of the external units, press key **LNB** [27], and the screen will display a functions menu labelled **EXT. SUPPLY** listing the choice of voltages (which will depend on the band being used). Use keys ⇧ ⇩ [6] to select the desired voltage and press key **ENTER** [5] to activate it. The following table shows the choice of supply voltages:

Band	Powering voltages
SATELLITE	External
	13 V
	15 V
	18 V
	13 V + 22 kHz
	15 V + 22 kHz
	18 V + 22 kHz
TERRESTRIAL	External
	13 V
	15 V
	18 V

Table 1.- External units powering voltages.

In the **External** power supply mode the unit powering the amplifiers before the antenna (terrestrial television) or the satellite TV receiver (house-hold or community) also powers the external units.

The **DRAIN** [9] indicator lights when current is flowing to the external unit. If any kind of problem occurs (e.g., a short circuit), an error message appears on the monitor ('SUPPLY SHORT'), the acoustic indicator will be heard and the instrument will cease to supply power. The **MTD 120** does not return to its normal operating state until the problem has been solved.

WARNING

When the external unit is powered with one of these voltages, particulary 18 V, it is not advisable for the instrument to function for more than three minutes non-stop. Since the total consumption is very high, the duration of the battery charge is shortened considerably. It is advisable to disconnect the instrument when it is not taking measurements.

ENGLISH

4.9.- TV Operating Mode

4.9.1.- Selecting the Measurement Mode (MEASURE)

The types of measurements available depend on the band, the standard, the operating mode and the options included in the appliance.

Terrestrial band - Analogue channels:

Level Level measurement of the currently tuned carrier.

Video / Audio Video carrier to audio carrier ratio.

C / N Video carrier to noise ratio. There are two methods to make this measurement (selectable through the **C/N setup** function):

Auto: In-channel measurement. Noise level is measured at a frequency where modulation contents is minimum. After a small period of time, minimum measured level corresponds to noise level.

Referenced: The user defines the frequency where noise level will be measured (by means of the **Reference noise** function). This frequency will be used to measure noise level for all channels.

Terrestrial band - Digital channels:

Channel power Automatic method: channel power is measured assuming that power spectral density is uniform throughout channel bandwidth. To measure it correctly it is indispensable to define the **Channel BW**.

C/N Two methods selectable through the **C/N setup** function:

Auto: Out-channel measurement. Noise level is measured at $f_{noise} = f_{tuning}$ - 1/2 Channel BW. To measure it correctly digital channel must be tuned at its central frequency.

Referenced: The user defines the frequency where noise level will be measured (by means of the **Reference noise** function). This frequency will be used to measure noise level for all channels.

Satellite band - Analogue channels:

Level Level measurement of the currently tuned carrier.

C/N Video carrier to noise ratio (**Auto** or **Referenced**, equivalent to terrestrial band, digital channels).

Satellite band - Digital channels

Channel power Automatic method.

C/N Channel level to noise ratio (**Auto** or **Referenced**, equivalent to terrestrial band, digital channels).

To change the measurement mode press key **LEVEL** [22]. The screen will display a menu with the measurement modes which can be selected.

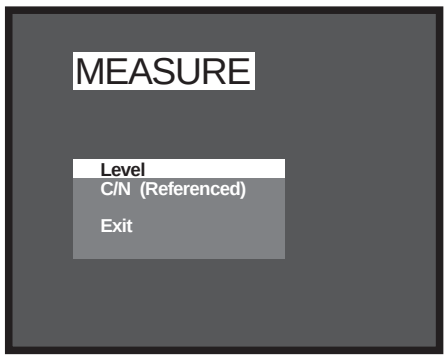

Figure 4.- Measuring mode selection (satellite band, analogue channels).

To select a measurement mode press keys ⇧ ⇩ [6] until it is marked (e.g., Level in the previous figure), then press key **ENTER** [5] or key **LEVEL** [22] to activate the selected measurement mode.

4.9.1.1.- Measuring the Video Carrier Level (Level)

If you select the **Level** measurement mode, the screen shows a window with the signal level, when selected with the key **MONITOR** [1] (see next section).

WARNING

If a sudden signal level increase is produced at the RF input, and it is beyond the total signal levels of:

Terrestrial band: 95 dBµV

Satellite band: 105 dBµV

the tuning circuit may become out of control, giving as a result wrong level readings.

If this situation occurs, disconnect the input signal, change to Spectrum Analyser mode and select a Reference Level of 130 dBµV. Then connect the signal again and modify the Reference Level according to present signals.

Similar effects can be observed when at the RF input appears an important number of carriers with a high level. To be able to determinate the equivalent level of a carrier group (with similar levels) at the RF input, it is possible to use the expression:

$L_t = L + 10 \log N$

L_t: equivalent total level

L: average level of the carriers group

N: number of carriers

So, if there are ten carriers with a level around 90 dBµV, their equivalent level will be:

90 dBµV + 10 log 10 = 100 dBµV

Observe that in this case, loss of tuning by overload of the RF input may occur besides other effects such as tuner saturation and generation of intermodulation products that may mask the spectrum visualization.

4.9.1.1.1.- On-screen Measurement Information

In TV operation mode, the measurement information to be displayed on-screen is selected by pressing key **MONITOR** [1]. Three possibilities are offered, selected cyclically:

- TV image with a window in the lower part of the screen displaying the signal level and frequency/channel.
- TV image with a window displaying information on the name assigned to memory, power supply to external units, sound, colour system, TV standard, level and frequency/channel.
- TV image only.

4.9.1.1.2.- Selecting TV Mode: TV, LV, SY (TV MODE)

In addition to operating as a television set, the monitor of the **MTD 120** can act as an analogue level indicator, and can display the line synchronising pulse just as it would appear on a screen of an oscilloscope.

To change the TV mode press key **MODE** [23], and the following screen will appear:

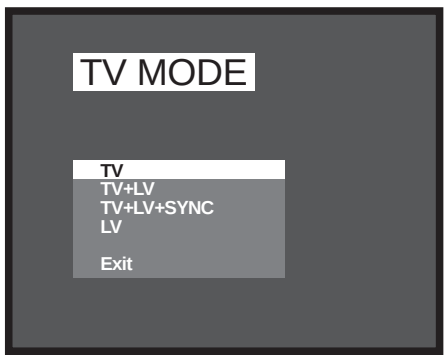

Figure 5.- TV mode selection.

Use keys ⇧ ⇩ [6] to choose the information you want to be displayed on-screen. Press key **ENTER** [5] or key **MODE** [23] to activate the selected display mode.

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The operation modes available are:

TV: Monitor operating as a conventional **television set.**

TV+LV: Monitor operating as a conventional **television set**, with a **level indicator** on the upper part of the screen (the analogue bar).

TV+LV+SY: Monitor operating as a conventional **television set**, with a **level indicator** and the **line synchronizing pulse** displayed on the screen.

LV: Signal **level indication** on the upper part of the screen (analogue bar).

Operation in TV+LV+SY Mode

This function permits to display the line synchronising pulse corresponding to a tuned signal on the monitor.

To view the synchronisation pulse press key **MODE** [23], use keys ⇧ ⇩ [6] to select **TV** + **LV** + **SY** mode, and then press key **MODE** [23] or key **ENTER** [5].

The monitor is divided into three sections. In the top section an analogue bar appears which indicates the level of the signal received (79 dBµV in figure 6 example). On the left side the line synchronising pulse is represented as it would appear on the screen of an oscilloscope. On the lower side the TV picture is shown.

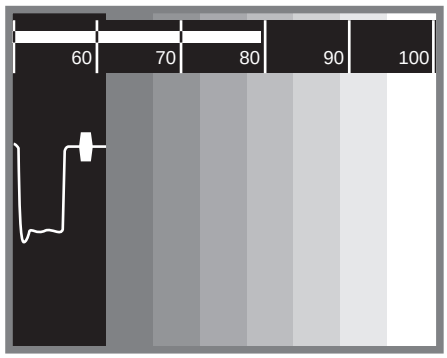

Figure 6.- Line synchronism + level + TV (TV+LV+SY).

Starting from the line synchronism representation, it is possible to perform a qualitative analysis of the TV picture delivered to the end user.

4.9.1.2.- Measuring the Video / Audio Ratio (V/A)

In the **Video/Audio** measurement mode, the screen displays the following information:

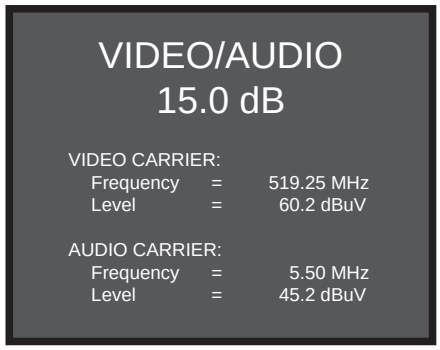

Figure 7.- Video/Audio rate measurement.

In addition to the video carrier / audio carrier ratio (15.0 dB in previous figure) this also shows the frequency or channel, depending on the tuning mode selected, and the level of the video carrier and audio carrier.

4.9.1.3.- Measuring the Carrier / Noise Ratio (C/N)

The **MTD 120** offers two ways to make this measurement:

Auto: The **MTD 120** defines the frequency where noise level is measured automatically.

Reference noise: The user defines the frequency where noise level is measured (by means of the **Reference noise** function). This frequency will be used to measure noise level for all channels.

To select the measuring method activate the TV mode functions menu by pressing key **ENTER** [5], then use keys ⇧ ⇩ [6] to select **C/N setup** function and finally press key **ENTER** [5] again. The monitor will show a screen displaying two possibilities: **C/N (Auto)** and **C/N (Reference noise)**, then use keys ⇧ ⇩ [6] to select the desired option and finally press key **ENTER** [5] to confirm.

When selecting the **C/N (Reference noise)** mode it is necessary to define the noise frequency: access the functions menu and now use keys ⇧ ⇩ [6] to select **Reference noise** function and finally press **ENTER** [5] again. A screen titled REFERENCE NOISE will be displayed showing the noise frequency in use. To change it press key **SHIFT** [31], the current frequency value will disappear and, using the keyboard, you will be able to enter the new reference noise frequency in MHz and with two decimals figures. This frequency also can be modified in the Spectrum operation mode (see 4.10.2.2. C/N (Referenced Measurement).

The **MTD 120** carries out C/N ratio measurement in four different ways, according to the carrier type and the band in use:

A) Terrestrial band, analogue carrier

Carrier level is measured using a quasi-peak detector (230 kHz BW). Noise level is measured with an average detector and corrected to refer it to channel bandwidth (according to the standard in use).

B) Terrestrial band, digital carrier

Both measurements are done with an average detector (230 kHz) and the same corrections are introduced on them (bandwidth corrections).

C) Satellite band, analogue carrier

Carrier level is measured using a quasi-peak detector (4 MHz BW). Noise level is measured with an average detector (4 MHz) and corrected to refer it to channel bandwidth.

D) Satellite band, digital carrier

Equivalent to case B but now using the 4 MHz BW filter.

On selecting the **Carrier** / **Noise** measurement mode the screen displays the following information:

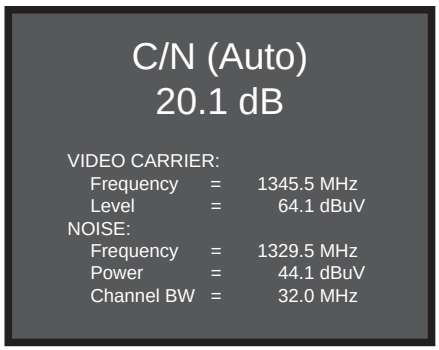

Figure 8.- Carrier-to-noise ratio measurement (Satellite band, analogue signal).

As well as the video carrier / noise level ratio (20.1 dB in previous figure), the frequency or channel (depending on the tuning mode selected) and the level of the video carrier and noise level are also shown.

When measuring channels in the satellite band or digital channels, to measure the C/N ratio correctly, the bandwidth of the channel must be defined previously, using the **Channel BW** function on the TV mode functions menu.

IMPORTANT REMARK

To measure digital channels C/N ratio in Auto mode it is indispensable to tune channel at its central frequency.

IMPORTANT REMARK

In the case of an analogue terrestrial signal, when C/N (Auto) mode is selected, the MTD 120 performs an in-channel measurement, this involves that C/N value will take several seconds to stabilize (six seconds at the most). An arrow below the C/N readout represents the measurement cycle and it is necessary to wait the arrow passes twice on the same point to guarantee a correct measurement.

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4.9.1.4.- Measuring the Power of Digital Channels (Channel power)

The **MTD 120** offers two different methods to measure digital channels power, according to the active operation mode: Automatic method in **TV mode** and Integration method in **Spectrum mode**. The **Automatic method** measures digital channel power in the measurement filter bandwidth and estimates total channel power assuming that spectral density is uniform throughout channel bandwidth. On the other hand, the **Integration method** takes into account signal spectral distribution so measurement is more accurate (see 4.10.2 Selecting the Measurements Mode). The obtained readouts using these methods may differ some dBs, specially when the digital signal is degraded.

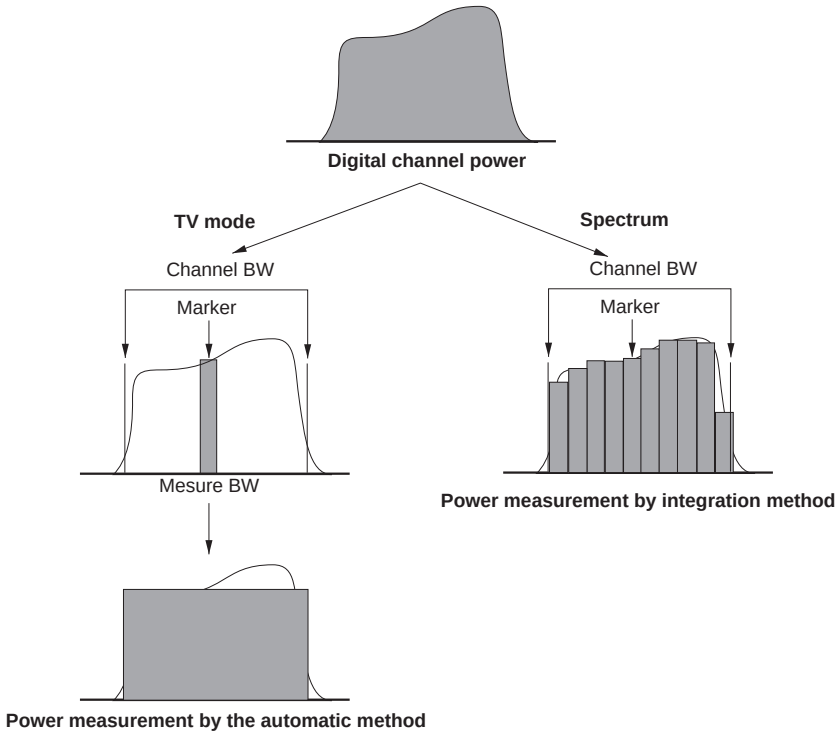

Figure 9.- Measuring digital power.

On selecting the **CHANNEL POWER** measurement mode, the screen displays the following information:

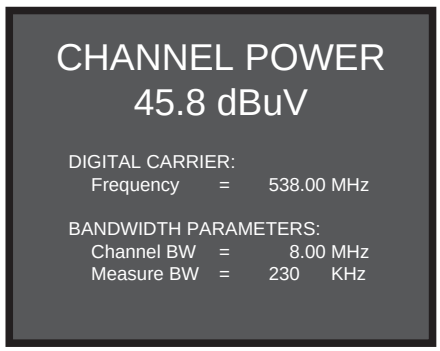

Figure 10.- Digital channel power measurement.

In addition to the power of the digital channel (45.8 dBµV in previous figure) this also shows the tuning frequency or channel, depending on the tuning mode selected, and the parameters regarding bandwidth: Channel BW and measuring filter bandwidth (Measure BW).

For the power measurement of a digital channel to be correct it is essential to have previously defined the channel bandwidth using the **Channel BW** function, in the TV mode functions menu (see section '4.9.2.11 Channel Bandwidth').

4.9.2.- TV Mode Functions Menu

In TV operation mode, press key **ENTER** [5] to access the functions menu of the TV mode:

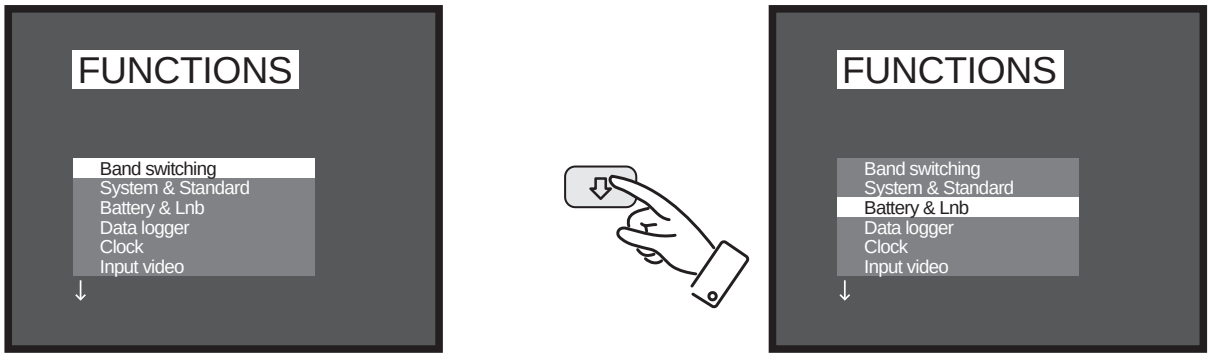

Figure 11.- TV mode functions menu.

Use keys ⇧ ⇩ [6] to choose the different functions: pressing key ⇧ active option moves upwards while pressing key ⇩ active option moves downwards. The downwards or upwards facing arrow at the bottom or top-left hand side of the functions menu indicates there are more menus which can be accessed by pressing keys ⇧ ⇩ [6].

Below we describe the use of each function and its range of values.

4.9.2.1.- Selection of the RF Band: (Band switching)

Permits to switch from terrestrial (5-862 MHz) to satellite band (920-2150 MHz) and vice versa.

4.9.2.2.- Selection of the TV System and Standard (System & Standard)

This function enables the television system and standard to be changed. The standards which can be selected depend on the band in use (terrestrial or satellite channels). To change the standard access the TV mode functions menu, then use keys ⇧ ⇩ [6] to select the **System & Standard** function and press key **ENTER** [5]. A fold down menu will appear listing the following options:

Terrestrial bands	**Satellite band**
PAL-B/G	PAL
PAL-D/K	SECAM
PAL-I	NTSC
PAL-M	Digital
PAL-N	
SECAM-B/G	
SECAM-L	
SECAM-D/K	
NTSC-M	
Digital	

Use keys ⇧ ⇩ [6] to select the desired standard and press key **ENTER** [5] to activate it.

If a digital channel is selected, whether terrestrial or satellite, for the measurement of the level and the carrier-to-noise ratio to be correct, the bandwidth of the channel must be defined, using the **Channel BW** function of the functions menu.

The following table shows the features of the analogue terrestrial channel standards.

System	Lines/frame	Channel Bandwidth	Video/sound separation	Video mode	Audio mode
B	625/50	7 MHz	5,5 MHz	Neg	FM
D	625/50	8	6,5	Neg	FM
G	625/50	8	5,5	Neg	FM
H	625/50	8	5,5	Neg	FM
I	625/50	8	6,0	Neg	FM
K	625/50	8	6,5	Neg	FM
L	625/50	8	6,5	Pos	AM
M	525/60	6	4,5	Neg	FM
N	625/50	6	4,5	Neg	FM

Table 2.- Selectable terrestrial analogue standards and their characteristics.

4.9.2.3.- Batteries and External Units Power Supply (Battery & Lnb)

This function allows you to check the charge state of the batteries, as well as the supply current and voltage of the external units. From the TV operation mode, simply press key **ENTER** [5] select the **Battery & Lnb** function and press key **ENTER** [5]again. You will see a screen like the following one:

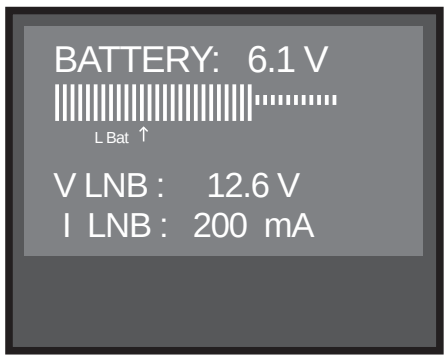

Figure 12.- Battery&Lnb function.

The top part of the screen displays the battery voltage (6,1 V in previous figure), both numerically and with a bar graph. The arrow labelled **L Bat** below the horizontal bar signals the low battery level where the battery should be charged. When batteries are fully charged, battery voltage indication is 6.1 V or higher.

The bottom of the screen shows the voltage supplied to the external units (**V LNB**, 12.6 V in the figure above) and the current supplied (**I LNB**, 200.0 mA in the example).

To leave this function press key **ENTER** [5].

4.9.2.4.- Data Logger Function

The **Data logger** function allows the user to carry out, store and/or print out up to 9801 measurements in a fully automatic way. It may be understood as a measurement matrix whose columns address the 99 measuring configurations (defined in the 99 memories of the equipment) and whose lines permit to store 99 measurements for every measuring configuration (conducted in different points of the system or in the same point on different times).

Before to proceed to take measurements by means of the **Data logger** function it is necessary to store the measuring configuration/s in the memory by using the **Store** function (see paragraph 4.12.1).

To select the **Data logger** function activate the TV mode functions menu, by pressing key **ENTER** [5] when in the TV operation mode. Then, use keys ⇧ ⇩ [6] to select the **Data logger** field and press key **ENTER** [5], the **DATALOGGER** screen will appear automatically.

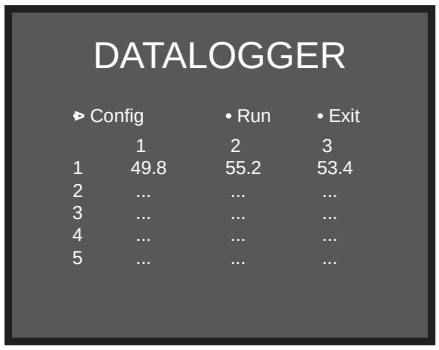

Figure 13.- DATALOGGER screen.

As you can see in the previous figure, the main screen of the Data logger function has three functions: **Config** (Configuration), **Run** and **Exit**. Below these three functions is the measurements matrix, three columns and five rows are simultaneously displayed (in the previous figure the data logger has three stored measurements, one for each of the first three memories).

To access the various screen functions or fields press key **SHIFT** [31] repeatedly.

4.9.2.4.1.- Configuring the Data Logger Function

The configuration menu of the **Data logger** function allows you to choose between taking and/or printing measurements, programming the **MTD 120** to take measurements at a pre-determined time, defining the time interval between measurements, erasing all measurements stored in the **Data logger** function, and automatically deactivating all the measurement configurations.

To define the configuration of the **Data logger** function press key **SHIFT** [31] repeatedly until you have selected the **Config** field and then press key **ENTER** [5]. The configuration screen of the **Data logger** function will then appear.

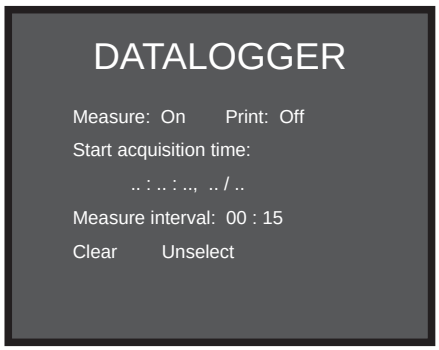

Figure 14.- Configuration of the DATA LOGGER function

After an interval of half a minute without the **MTD 120** controls being touched, it will automatically return to the Data logger function main screen.

1.- TO MEASURE, PRINT OR MEASURE AND PRINT?

First of all, the user must indicate whether he wants to take measurements or to print them, or to do both at the same time. To do this, press key **SHIFT** [31] repeatedly until positioned in the **Measure field**. Then use keys ⇧ ⇩ [6] to activate (**On**) or deactivate (**Off**) the measurement function and press key **SHIFT** [31]. The next step is to activate or deactivate the measurement printing function. To do this, use the key **SHIFT** [31] to position the cursor in the **Print** field and activate it (**On**) or deactivate it (**Off**) using keys ⇧ ⇩ [6] and pressing key **ENTER** [5] validate the new state.

2.- PROGRAMMING THE ALARM

To program the instrument to take measurements and/or print-outs at a specific time, you must define the time and date the measurements are to be taken (**Start acquisition time**). If this field is not defined the acquisition of measurements will have to be activated manually (see section '4.9.2.4.3 Taking Measurements'). When programming the alarm be sure to have checked that the date and time have been correctly defined beforehand (**Clock** function, paragraph 4.9.2.5) and to have selected previously one measurement to be taken at minimum (see section '4.9.2.4.2 Selecting the Measurements to be Taken').

To define the starting time of measurement acquisition repeatedly press key **SHIFT** [31] until the **Start acquisition time** field blinks, then

press key **ENTER** [5]. This will lead to a screen like the one shown below:

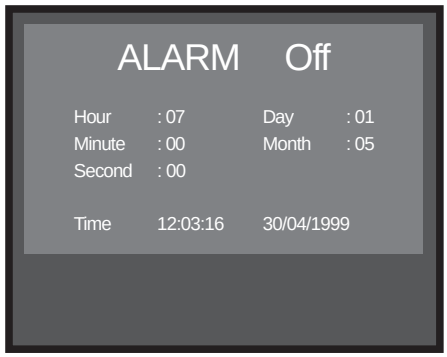

Figure 15.- Defining the starting time of measurement acquisition.

The first line of this screen tells you if the alarm function is on (**ALARM On**) or not (**ALARM Off**), followed by the date and time the alarm has been set for, and the last line shows the current time and date.

Repeatedly pressing key **SHIFT** [31] cyclically activates the different fields in the following order: **Hour**, **Minute**, **Second**, **Day**, **Month** and **Alarm** (alarm state). To alter any of these simply activate it, using keys ⇧ ⇩ [6] and press key **SHIFT** [31] again. Once you have updated all the alarm fields, press key **ENTER** [5] to validate them and exit the screen.

If before activating the alarm (**ALARM On**) no measurement matrix cell has yet been activated (see section '4.9.2.4.2 Selecting the Measurements to be Taken'), the bottom of the screen will show the error message "**NOT CELLS SEL.**" (No cells have been selected) followed by "**DL STOPPED**" (Data Logger deactivated).

On reaching the time defined in the **Start acquisition time** field, the instrument will switch itself on (if it was switched off) or go to the **Data logger** mode (if switched on) to automatically take the measurements and/or produce the print-out.

3.- MULTIPLE MEASUREMENTS: INTERVAL BETWEEN MEASUREMENTS

In the case of having to take multiple measurements at different times the **Measure interval** will have to be defined. This field specifies the time interval between measurements/print-outs. To define it, from the Data logger configuration screen, repeatedly press key **SHIFT** [31] until the section dealing with time in the **Measure interval** field has been activated, define the hours by using keys ⇧ ⇩ [6], then press key **SHIFT** [31] again to go to the minutes field and define these in the same way. Finally press key **SHIFT** [31] again to validate the defined time interval.

You can make as many acquisitions as there are activated rows in the measurement matrix (if only one row has been activated, then only one measurement will be taken).

In the case where the **Data logger** function has been programmed to take more than one measurement in the time domain, i.e. more than one row has been activated and the acquisition interval is greater than four minutes, then every time an acquisition is made the instrument will reprogram the alarm for the next measurement. Then it will switch itself on three minutes before the time defined in the Measure Interval field in order to warm up and ensure the highest accuracy.

4.- ERASING MEASUREMENTS STORED IN THE DATA LOGGER AND AUTOMATIC DEACTIVATION OF ALL THE CELLS.

The configuration screen also allows you to erase all the measurements stored in the **Data Logger** function, as well as automatically deactivating all the activated measurement configurations. To erase the stored measurements select the **Clear** field and press key **ENTER** [5]. To deactivate the measurement configurations select the **Unselect** field and press key **ENTER** [5].

5.- EXITING THE CONFIGURATION SCREEN

To exit the **Data logger** function configuration screen press key **ENTER** [5].

4.9.2.4.2.- Selecting the Measurements to be Taken

Once the **Data logger** function has been configured, activate the measurement configuration(s) (columns) which you would like to use. The headings of the measurement matrix columns of the Data logger function coincide with the number of memorised measurement configurations, simply place the cursor over each column and you will see the more important parameters displayed at the bottom of the screen (name assigned to the memory position, frequency/channel, measurement mode and units of measurement).

To activate the measurement configurations repeatedly press key **SHIFT** [31] until the cursor is placed on the **columns field**, next pressing keys ⇧ ⇩ [6] until it is positioned in the column (memory) that you wish to activate and press key **ENTER** [5]. The activated columns are more brilliant than the non activated ones. To deactivate a column follow the same steps as in activating it.

To activate rows where you wish to store measurements use key **SHIFT** [31] to place the cursor on the **rows** field, then press keys ⇧ ⇩ [6] until it is over the row you want to activate and press key **ENTER** [5]. The activated rows are more brilliant than the non activated ones. To deactivate a row follow the same steps as in activating it. In the case of activating more than one row, the time interval between the measurement of each row is determined by the **Measure interval** parameter defined in the configuration screen (1 minute by default).

4.9.2.4.3.- Taking Measurements

In addition to execution by alarm (see section '4.9.2.4.1 Configuring the Data Logger Function') there are three more ways to take measurements:

a) **Acquisition over a time period.**

The measurement defined in a memory (column) will be taken as many times as there are activated rows, as specified by the time interval between measurements defined in the configuration menu (**Measure interval**).

Process: place the cursor on the column you want and press key **ENTER** [5] until the first active cell blinks. If no measurement matrix row has been previously activated, the bottom of the screen will show the error message "NOT CELLS SEL." (No cells selected).

b) **Acquisition of different measurements at the same moment.**

Multiple measurements in a row will be taken, as specified by the measurement configurations defined in all the activated columns.

Process: place the cursor on the row you want and press key **ENTER** [5] until the active cells blink. If no measurement matrix column has been previously activated, the bottom of the screen will show the error message "NOT CELLS SEL.".

c) **Multiple acquisitions.**

All the measurements defined by all the activated rows and columns will be taken, in the case where more than one row has been activated the time interval between measurements will be that defined in the **Measure interval** field of the configuration menu.

Process: select the **Run** function and press key **ENTER** [5]. If no measurement matrix element has been previously activated, the bottom of the screen will show the message "NOT CELLS SEL.".

If any key is pressed during the acquisition process, the acquisition process will abort and the screen will display the message "DL STOPPED" (Data Logger deactivated).

4.9.2.4.4.- Exiting the Data Logger Function

To exit the **Data logger** function select the **Exit** field using key **SHIFT** [31] then press key **ENTER** [5].

4.9.2.4.5.- Examples of Data Logger Function Applications

The **Data logger** function has many applications such as channel equalisation and measuring signal attenuation at each pickup.

Band Equalisation (frequency acquisition)

For this application you will need to use a noise generator as the signal source in the place of a receiver antenna. If, lets say, you wish to verify equalisation on the VHF band, then:

1. Define the following tuning frequencies at 8 memory positions: from 50 to 450 MHz in 50 MHz steps. The measurement to be taken will be the level measurement.
2. In the Data logger function, activate the columns related to the memories defined in the previous step.
3. Next place the cursor on the row where you want to store the measurements and press key **ENTER** [5] until the first of the cells blinks.

The measurements obtained will allow you to verify if the signal level is uniform across the entire band.

Measuring signal level fluctuation at a pickup (acquisition over a time period)

1. Define the acquisition time interval **Measure interval** (1 h for example).
2. Activate a column (a measurement configuration you consider significant).
3. Activate the necessary number of rows to be able to perform the study over the decided upon period of time, taking into account the previously defined acquisition interval (e.g. for a 24 hour study with an acquisition interval of 1 h you will need to activate 24 rows).
4. Finally place the cursor on the activated column and press key **ENTER** [5] until the first active cell blinks.

The report obtained will allow you to guarantee the correct operation of the installation.

4.9.2.5.- Clock

An internal clock permits to record date and hour of data acquisitions.

To modify the time/date access the TV mode functions menu, press keys ⇧ ⇩ [6] to select the **Clock** function and press key **ENTER** [5] to activate it. The monitor will show a screen labelled CLOCK displaying the hour, minute, second, day, month and year.

To alter any parameter repeatedly press key **SHIFT** [31] until the parameter you want to modify appears shadowed, then press keys ⇧ ⇩ [6]. If you want to alter more parameters repeatedly press key **SHIFT** [31] again. To validate the changes made and exit press key **ENTER** [5].

4.9.2.6.- Input Video

The **Input video** function enables Scart connector signals to be controlled. There are three possibilities:

Scart Auto	Normal Scart operation
Scart On	External video operation mode
Scart Off	Scart deactivated

To select the Scart operation mode, access the TV mode functions menu, press keys ⇧ ⇩ [6] to the **Input video** function and press key **ENTER** [5] to activate it. The monitor will show a screen labelled **INPUT VIDEO** displaying the three available options (as well as the **Exit** option). Press keys ⇧ ⇩ [6] to select the mode you require, then press key **ENTER** [5] to activate it.

4.9.2.7.- Selecting the Channels Table (Channel set)

The **MTD 120** comes with twelve stored channel tables as standard (four for terrestrial television and eight for satellite), for greater adaptability to the selection requirements of different countries or zones. See the channel-frequency table in appendix A of the manual.

To modify one channel table, access the TV mode functions menu, press keys ⇧ ⇩ [6] to select the **Channel set** function and press key **ENTER** [5] to activate it. The monitor will then show the **CHANNEL SET** screen. Press keys ⇧ ⇩ [6] to select the desired table and then presss key **ENTER** [5] again to activate it.

4.9.2.8.- Measurement Units

The **MTD 120** offers three measurement units to measure level and channel power: **dBµV**, **dBmV** and **dBm**.

To select the units of measurement, access the TV mode functions menu, press keys ⇧ ⇩ [6] to select the **Units** function and press key **ENTER** [5] to activate it. The monitor will show a screen labelled **UNITS** displaying the three available options (as well as the **Exit** option). Press keys ⇧ ⇩ [6] to select the units you require, then press key **ENTER** [5] to activate it.

4.9.2.9.- Power Off Mode (Manual power)

The **MTD 120** offers two power-off modes: **Manual** and **Automatic** (unit disconnects automatically after 15 minutes without operating on any control).

To select the power-off mode, access the TV mode functions menu, press keys ⇧ ⇩ [6] to select the **Manual power** function and press key **ENTER** [5] to activate it. The monitor will show a screen labelled **POWER OFF** displaying the two available options (as well as the **Exit** option). Press keys ⇧ ⇩ [6] to select the power-off mode you require, then press key **ENTER** [5] to activate it.

4.9.2.10.- C/N setup

To measure C/N the **MTD 120** offers two different modes in TV mode:

C/N (Auto)	The **MTD 120** defines automatically the frequency where noise level is measured, according with: $f_{noise} = f_{tuning}$ - 1/2 Channel BW
C/N (Reference noise)	The user defines the frequency where noise level is measured (by means of the **Reference noise** function). This frequency will be used to measure noise level for all channels.

To select C/N mode, access the TV mode functions menu, press keys ⇧ ⇩ [6] to select the **C/N setup** function and press key **ENTER** [5] to activate it. The monitor will show a screen labelled **C/N SETUP** displaying the two available options (as well as the **Exit** option). Press keys ⇧ ⇩ [6] to select the mode you require, then press key **ENTER** [5] to activate it.

4.9.2.11.- Channel Bandwidth (Channel BW)

To measure the power and C/N ratio of digital channels, as well as the C/N ratio of satellite band channels, you first need to define the channel bandwidth.

To modify the bandwidth access the TV mode functions menu and select the **Channel BW** function, press key **ENTER** [5] to activate it. The **CHANNEL BANDWIDTH** screen will be displayed. To alter the bandwidth value press key **SHIFT** [31], the bandwidth will disappear and, using the keyboard, you will be able to enter the new digital channel bandwidth in MHz and with two decimals.

4.9.2.12.- LNB Local Oscillator Frequency (Lnb local osc)

This option only affects reception of satellite band signals when using the channel tuning mode. This function defines the LNB local oscillator frequency used in the installation where the **MTD 120** has been connected. Given that the **MTD 120** satellite channel tables have been defined in the Ku band and the **MTD 120** tunes in IF (like all satellite receivers) the LNB local oscillator frequency has to be defined to correctly tune the channel mode.

To modify this parameter access the TV mode functions menu (satellite band), press keys ⇧ ⇩ [6] to select the **Lnb local osc** function and press key **ENTER** [5] to activate it. The monitor will show a screen labelled **LNB LOCAL OSCILLATOR** displaying the current value of the LNB local oscillator frequency. To alter this value press key **SHIFT** [31], the current value will disappear and the new value can now be entered using the keyboard.

The frequency of the LNB local oscillator is expressed in MHz, with 5 figures for the whole part, a decimal point and a decimal figure (which acts as confirmation). For example, to select 9 GHz the number **9000.0** has to be entered. Values must be defined between 8000.0 and 12000.0.

4.9.2.13.- Video Polarity

This option affects reception of SAT (satellite) band signals. It allows selection of either negative and positive video polarity.

To modify the polarity access the TV mode functions menu (satellite band), select the **Video Polarity** function, and press key **ENTER** [5] to activate it. The monitor will show a screen labelled **POLARITY** displaying two possibilities: **Positive Video** and **Negative Video**. Pressing keys ⇧ ⇩ [6] mark the option you require and finally press key **ENTER** [5] to activate it.

4.9.2.14.- NICAM Channel

Use this function to verify NICAM sound modulations in stereo and dual, you can also select the sound channel coming over the speaker.

To change the decoded channel access the TV mode functions menu, select the **Nicam channel** function, and press key **ENTER** [5] to activate it. The monitor will show a screen labelled **NICAM** offering two possibilities: **Channel A** and **Channel B**. Press keys ⇧ ⇩ [6] to select the desired option and finally press key **ENTER** [5] to activate it.

4.9.2.15.- Search Level

Use this function to modify the threshold level of the automatic station search. To change the level place the cursor on the **Search level** field and press key **ENTER** [5]. The monitor will display a window showing the current value of the search level, to alter it press key **SHIFT** [31] and enter the new value on the keyboard. Confirmation is automatic on entering the second digit.

4.9.2.16.- Teletext

When the **Teletext** function is selected, Teletext information appears on the monitor if a transmitter with this information is tuned. The first page to appear on the screen is always page 100. If Teletext data is received, a counter located on the upper edge of the screen indicates the page that is being processed. To change active page press key **SHIFT** [31], and introduce the new number using the numeric keyboard (third digit acts as confirmation).

If the page requested is not included in the Teletext service of the transmitter, the search will continue indefinitely. In such a situation the user can halt the search process, either by entering a new page number or by exiting the Teletext function pushing any control relative to another function.

The Teletext function is especially valuable for the final optimization process in TV installations. Any interference or reception through indirect beams generates digital in the digital information of the Teletext, which are highly visible as erroneous characters on the screen.

4.9.2.17.- DiSEqC (*) Command Generator

DiSEqC ('Digital Satellite Equipment Control') is a communication protocol between the satellite receiver and the accessories of the installation (switches, LNBs, etc.) proposed by Eutelsat, with the aim to standardize the diversity of switching protocols (13 - 15 - 18 V, 22 kHz, 60-400 Hz) and to satisfy the demands of the digital TV installations.

To define and/or to send a DiSEqC commands sequence, from the TV operation mode, press key **ENTER** [5], select the **DiSEqC** function using keys ⇧ ⇩ [6] and press key **ENTER** [5] again. A screen like next one will appear:

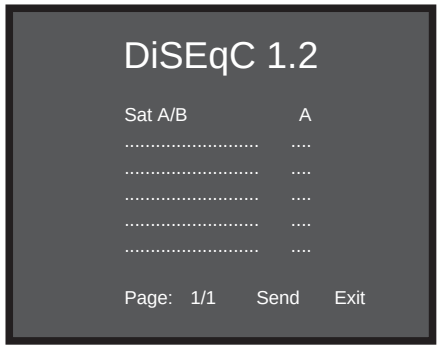

Figure 16.- DiSEqC commands screen.

DiSEqC screen is divided in 3 areas: the field to edit the **DiSEqC commands sequence** (only command Sat A/B in previous figure), **Send/Clear** functions and **Exit**.

To define the **DiSEqC commands sequence** press key **SHIFT** [31] repeatedly until cursor is positioned on one line of the commands sequence (the line will blink). If cursor has been placed on the first empty line, Sat A/B command will appear (first DiSEqC command of table 3). To select a different command press keys ⇧ ⇩ [6] until the desired command appears and then press key **ENTER** [5].

Some DiSEqC commands need to define an associated parameter (i.e. On/Off, a numerical value, A/B...), when any of these commands is selected first option for the associated parameter appears automatically at its right, to change it press keys ⇧ ⇩ [6] and to validate it press key **ENTER** [5] (see DiSEqC commands table).

Once the DiSEqC command is defined, the cursor will pass to the following line, if you want to define a new command proceed as for the first one, if you do not want to add any command press key **SHIFT** [31].

After the commands sequence is created it is possible to modify it. To modify the sequence press key **SHIFT** [31] repeatedly until you have positioned the cursor on the command you want to make the change and then press key **ENTER** [5]: **Insert** function will appear on the screen, by pressing keys ⇧ ⇩ [6] it is possible to select **Delete** and **Edit** functions. Once the desired function appears on the screen (Insert, Delete or Edit) press **ENTER** [5].If you select **Delete** function the command will be removed from the sequence, if you select **Insert** or **Edit** functions, you must define the new command as previously described.

Once commands sequence is defined, to send it to the peripherals press key **SHIFT** [31] repeatedly until you have selected the **Send** function and then press key **ENTER** [5]. At the same time as DiSEqC commands are sent these appear on the lower side of the monitor. If **Send** function does not appear on the monitor, place the cursor over the **Clear** function and press keys ⇧ ⇩ [6].

It is possible to delete the whole of the commands sequence, to do this press key **SHIFT** [31] repeatedly until you have selected the **Clear** field and then press key **ENTER** [5]. If **Clear** function does not appear on the monitor, place the cursor over the **Send** function and press keys ⇧ ⇩ [6].

To exit DiSEqC function place the cursor over the **Exit** field and then press key **ENTER** [5].

REMARK: When disconnecting the unit, the commands sequence will NOT be lost.

Next table shows the DiSEqC commands available:

(*) DiSEqC™ is a trademark of EUTELSAT.

Character	Command	Associated parameter
General	Sat A/B	A/B
	Reset	---
	Power ON	---
	Standby	---
Destined	L.O. frequency High/Low	
Switch	H/V polarisation	H/V
	Position A/B	A/B
	Sw. option A/B	A/B
Non-destined	Switch 1	A/B
Switch	Switch 2	A/B
	Switch 3	A/B
	Switch 4	A/B
Positioner	Halt	---
	Disable limits	---
	Enable limits	
	Limit East	---
	Limit West	---
	Drive E. seconds	1 to 127
	Drive E. steps	1 to 128
	Drive W. seconds	1 to 127
	Drive W. steps	1 to 128
	Store position	1 to 255
	Goto position	1 to 255

Tabla 3.- DiSEqC commands.

4.9.2.18.- Beep

This function allows the user to switch the audible indicator ON and OFF. To do this, first select the TV mode functions menu, then choose the **Beep** function using the keys ⇧ ⇩ [6] and press key **ENTER** [5]. The monitor will show the **BEEP** screen and by pressing keys ⇧ ⇩ [6] it will be possible to select between **Beep ON** or **Beep OFF**. To validate press key **ENTER** [5] again.

4.9.2.19.- Equipment Information

This function displays information on the instrument. To activate it, press key **ENTER** [5], while in the TV operation mode. Press keys ⇧ ⇩ [6] to select the **Equipment Info.** function and press key **ENTER** [5]. The monitor will show the **EQUIPMENT INFO.** screen listing several informations such as the instrument serial number (Serial Number), the version of the control program (Version), etc.

To exit the function press key **ENTER** [5].

4.9.2.20.- Exit

Exits from the TV functions menu.

4.10.- Spectrum Analyser Operating Mode

The Spectrum Analyser mode allows the user to discover the signals present in the frequency band in quickly and easily and to make measurements at the same time. To select it press key **SPECT** [21]. The monitor will show a picture like the one described in the next figure.

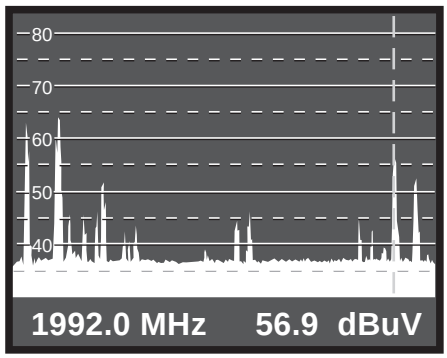

Figure 17.- Spectrum Analyser mode.

The horizontal lines define the signal level, the broken lines being 5 dB from the solid ones. The level of the top line (80 dBµV in previous figure), named the Reference Level, can be altered using the **Reference level** function in the Spectrum Analyser mode functions menu (section 4.10.1.3).

The signal level for each frequency is displayed vertically, the lower frequencies appearing at the left of the screen and the higher ones at the right. The amplitude of the lobes is calibrated. In the example in previous figure the noise level is at around 37 dBµV and the lobe with the highest signal level (second from the left) is at 64 dBµV.

The frequency range displayed (called **span** from hereon) can also be altered using the Spectrum Analyser mode functions menu.

A vertical broken line, called **marker**, appears on the spectrum display to identify the tuned frequency.

One of the applications of the **MTD 120** operating as Spectrum Analyser is in the search for the best orientation and position of the receiving antenna. This is particularly important in UHF. Because such frequencies are involved, with wavelengths ranging from 35 cm to 65 cm, if the antenna is shifted only a few centimetres, the relationship between the picture, chrominance and sound carrier frequencies change, affecting the quality of the picture in the receiver.

If there is an excess of sound carrier, tearing or 'moiré' may appear on the screen due to the frequency beats between the sound, chrominance and the picture frequencies.

If there is a chrominance carrier defect, then the television colour amplifier must function at maximum gain, which could result in noise appearing all over the television screen with points of colour that disappear when the saturation control is reduced; in an extreme case, loss of colour may occur.

4.10.1.- Spectrum Analyser Mode Functions Menu

In the Spectrum Analyser operation mode, pressing key **ENTER** [5] leads you to the next functions menu.

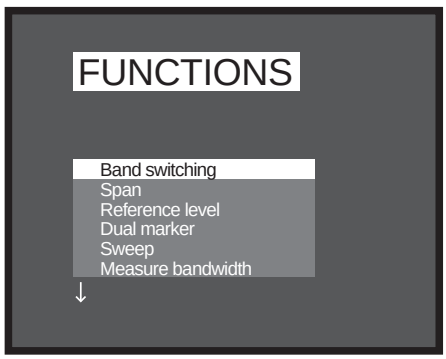

Figure 18.- Spectrum Analyser mode functions menu.

When press key ⇧ [6] active option moves upwards while press key ⇩ [6] active option moves downwards.

The downward pointing arrow at the bottom left of the menu means that there are more functions available, to view these press key ⇩ [6]. Below we describe the use of each function and its range of values.

4.10.1.1.- Band Switching

Permits to swicth from terrestrial (5-862 MHz) to satellite band (920-2150 MHz) and vice versa.

4.10.1.2.- Span

This function enables selecting the displayed frequency range in Spectrum Analyser mode between **Full** (the entire band), **500 MHz, 200 MHz, 100 MHz, 50 MHz, 32 MHz, 16 MHz** and **8 MHz** (the latter two only in terrestrial bands).

To alter the **span**, select the functions menu, then press keys ⇧ ⇩ [6] to select the **Span** function and press key **ENTER** [5]. The screen will show a window with the spans which can be selected. Press keys ⇧ ⇩ [6] to select the required span and activate it by pressing key **ENTER** [5] again.

In **Full** mode the measuring filter bandwidth used to display the spectrum is always 1 MHz for terrestrial bands, and 4 MHz for satellite band. For the other spans you can select the bandwidth using the **Measure Bandwidth** function on the same functions menu. (See section '4.10.1.10 Bandwidth of the Spectrum Measuring Filter').

4.10.1.3.- Reference Level

The reference level corresponds to the level marked by the top horizontal line appearing on the Spectrum Analyser mode screen. This function enables the reference level to be defined between **70** and **130 dBµV** in **10 dB** steps. The default reference level is 70 dBµV.

To alter the value of the reference level select the Spectrum Analyser mode functions menu, press keys ⇧ ⇩ [6] to select the **Reference level** function and press key **ENTER** [5]. The screen will show a window with the values which can be selected. Press keys ⇧ ⇩ [6] to select the desired reference level and activate it by pressing key **ENTER** [5] again.

4.10.1.4.- Dual Marker/Single Marker

(Only for level measurements) This function enables two tuning markers (**Dual marker**) to be seen on the spectrum display. When you choose this option you can select the active marker (**Marker A** or **Marker B**) or return to using only one marker (**Single marker**).

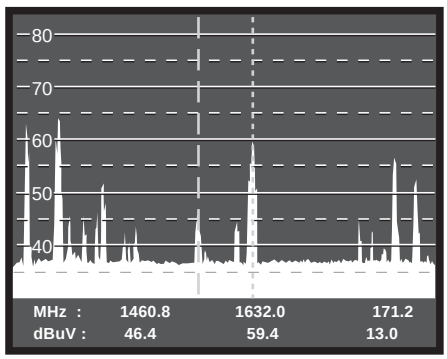

Figure 19.- Spectrum Analyser mode with two tuning markers.

When you select the **Dual marker** function, the bottom of the screen displays the frequency of each of the two markers, the signal level for each frequency and, on the far right, the frequency difference and the level between them.

4.10.1.5.- Sweep

Enables you to choose the sweep speed of the Spectrum mode between **High Resolution** (slow sweep, high precision) and **Fast** (fast sweep, low precision).

To modify the sweep speed select the Spectrum Analyser mode functions menu, then press keys ⇧ ⇩ [6] to select the **Sweep** function and press key **ENTER** [5]. The screen will show a window containing all the values which may be chosen. Press keys ⇧ ⇩ [6] to select the desired speed and activate it by pressing key **ENTER** [5] again.

4.10.1.6.- Reference Noise

(Only in C/N measurements). Permits to define the frequency where noise level will be measured.

To modify the frequency where you want to measure noise level, accede to the menu functions and select the **Reference noise** function then, again in the Spectrum mode, press keys ⇧ ⇩ [6] to place the marker on the frequency where you want to measure the noise level or well, press key **SHIFT** [31], current reference noise frequency will be erased and using the keyboard introduce the new value. Finally accede to the functions menu again and execute the **Carrier** function so that you can tune new carrier frequencies by pressing keys ⇧ ⇩ [6] .

4.10.1.7.- Channel Bandwidth

(Only in Channel Power measurements). Permits to define channel bandwidth.

To modify the channel bandwidth, that is to say the power integration limits, accede to the menu functions and select the **Channel bandwidth** function then, again in the Spectrum mode, press keys ⇧ ⇩ [6] to modify it or well press key **SHIFT** [31], current channel bandwidth will be erased and using the keyboard introduce the new value. Finally accede to the functions menu again and execute the **Marker** function so that you can tune new carrier frequencies by pressing keys ⇧ ⇩ [6] .

4.10.1.8.- Marker

(Only when measuring Channel power and after defining the **Channel bandwidth**). Permits to change the tuning frequency by means of keys ⇧ ⇩ [6].

4.10.1.9.- Carrier

(Only when measuring C/N Referenced and after defining the **Reference noise**). Permits to change the tuning frequency by means of keys ⇧ ⇩ [6].

4.10.1.10.- Bandwidth of the Spectrum Measuring Filter (Measure bandwidth)

The frequency resolution of the Spectrum Analyser mode is determined by the bandwidth of the measuring filter when displaying the spectrum. This parameter is fundamental given the increasing density of channels present in all TV transmission systems.

To alter the bandwidth of measurement select the Spectrum Analyser functions menu, then press keys ⇧ ⇩ [6] to select the **Measure bandwidth** function and press key **ENTER** [5]. The screen will show a window displaying the values which can be selected. Pressing keys ⇧ ⇩ [6] to select the chosen bandwidth and activate it by pressing key **ENTER** [5] again.

The choice of bandwidth is:

Terrestrial channels:	**230 kHz or 1 MHz**
Satellite channels:	**230 kHz or 4 MHz**

Filters with the greatest bandwidth (4 MHz y 1 MHz) allow you to take more stable measurements, as well as being able to distinguish between analogue and digital carriers. The 4 MHz filter is ideal for level measurements on the satellite band. The 230 kHz filter is recommended for measuring terrestrial television, cable television and MMDS signals. It also allows you to identify smaller bandwidth signals such as NICAM sound carriers (terrestrial analogue channels), to detect the beacon signal on VSAT, the separation between the audio FM carrier, and between the stereo sub-carriers in television.

4.10.1.11.- Selecting the Channels Table (Channel set)

See 4.9.2.7 section.

4.10.1.12.- Batteries and External Units Power Supply (Battery & Lnb)

See 4.9.2.3 section.

4.10.1.13.- Exit

Exits from the Spectrum Analyser function menu.

4.10.2.- Selecting the Measurement Mode

The Spectrum Analyser mode permits to make different measurements at the same time you see the signals present in the band. The types of measurements available are:

Terrestrial band - Analogue channels:

Level	Level measurement of the currently tuned carrier.
C/N	Video carrier to noise ratio referenced to a noise frequency defined by the user through the **Reference Noise** function.

Terrestrial band - Digital channels:

Channel power	Integration method. It consists of scanning the entire channel, calculating the contribution of each portion of the spectrum to the whole.
C/N	Referenced: Channel level to noise ratio referenced to a noise frequency defined by the user through the **Reference Noise** function.

Satellite band - Analogue channels:

Level	Level measurement of the currently tuned carrier.
C/N	Video carrier to noise ratio referenced to a noise frequency defined by the user through the **Reference Noise** function.

Satellite band - Digital channels

Channel power	Integration method.
C/N	Referenced: Channel level to noise ratio referenced to a noise frequency defined by the user through the **Reference Noise** function.

Like in the TV mode, to select the type of measure, press key **LEVEL** [22], then press keys ⇧ ⇩ [6] until desired mode is marked and finally press key **ENTER** [5] or key **LEVEL** [22] to activate the new measurement mode.

4.10.2.1.- Measuring Carrier Levels (Level)

(Only for analogue channels). When selecting this mode on the lower part of the image appears the tuned frequency (or channel) and the signal level at this frequency. If dual marker function is selected, tuned frequency and signal level are showed for each one of the markers and, on the far right, the frequency difference and the level between them.

4.10.2.2.- Measuring the Carrier / Noise ratio (C/N Referenced)

The Carrier/Noise ratio in Spectrum mode is always referenced to a noise frequency defined by the user.

Imagine a situation like the one shown in the next figure: a digital channel (8 MHz BW) adjacent to an analogue channel. When measuring C/N for the digital channel in TV mode using the Auto setup, the analogue channel may interfere in the noise measurement (given that the noise level is measured at $f_{noise} = f_{tuning}$ - 1/2 Channel BW= 650 MHz - 4 MHz = 646 MHz) so under this situation it is recommended to make the measurement in **Spectrum Analyser** mode and to define manually the frequency where we want to measure noise (obviously a frequency where no signal is present); i.e. in the next figure noise is defined to be measured at 655 MHz.

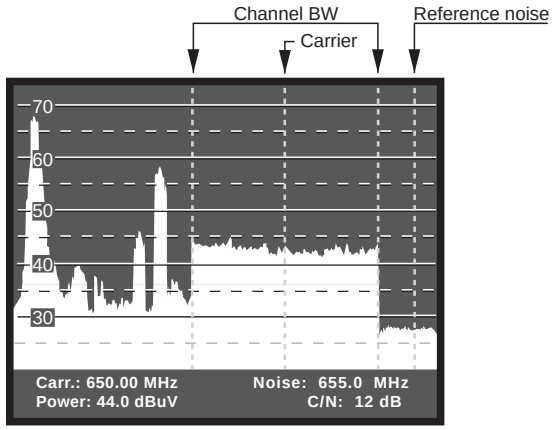

Figure 20.- Carrier to Noise measurement in Spectrum mode (digital channel).

To define the frequency to measure the noise, select the **Reference noise** function in the Spectrum functions menu and press key ENTER [5]. Next, again in the Spectrum mode, press keys ⇧ ⇩ [6] to place the marker on the frequency where you want to measure noise level or press key **SHIFT** [31], current reference noise value will be erased and using the keyboard introduce the new value. Finally accede to the functions menu again and execute the **Carrier** function so that you can tune new carrier frequencies by keys ⇧ ⇩ [6].

When C/N measuring mode is selected, on the lower part of the image appears the tuned frequency/channel (**Carr.**), the noise frequency (**Noise**), the carrier **Level** (if analogue mode is selected) or the channel **Power** (if digital mode is selected) and the carrier to noise ratio (**C/N**).

4.10.2.3.- Measuring the Power of Digital Channels (Channel Power)

In the Spectrum Analyser mode the **MTD 120** measures digital channel power using an **Integration method** between channel limits which are defined by the user. To show the interest of this method, imagine a spectral distribution like the one shown in the following figure (channel bandwidth is 8 MHz defined by the markers). If channel power is measured in TV operation mode different readouts will be obtained depending on the tuned frequency (measurement filter bandwidth is 230 kHz), if tuning is shifted from 759 MHz to 762 MHz reading will increase in several dB.

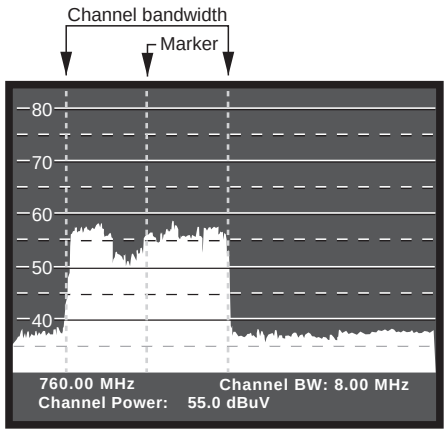

Figure 21.- Channel power measurement in Spectrum Mode.

When measuring Channel power, on the lower part of the image appears the tuned frequency (or channel), the channel bandwidth (**Channel BW**) and the **Channel Power**.

To measure the channel power, first of all it is necessary to define channel bandwidth, that is to say to set the limits of the integration: select the **Channel bandwidth** function in the functions menu and then, again in the Spectrum mode, press keys ⇧ ⇩ [6] to modify it or well press key **SHIFT** [31], current channel bandwidth will be erased and using the keyboard introduce the new value. Finally accede to the functions menu again and execute the **Marker** function in order you can tune new carrier frequencies, then when pressing keys ⇧ ⇩ [6], the tuning marker and the channel bandwidth limits will shift together.

IMPORTANT REMARK

To measure digital channels power correctly it is indispensable to tune channel at its central frequency and to define channel bandwidth.

4.11.- Selecting the Sound Mode (Sound)

From the TV operating mode, analogue mode, press key **SOUND** [26]. The screen will show the SOUND menu with the types of sound available. Pressing keys ⇧ ⇩ [6] choose the type of sound you wish and then press key **SOUND** [26] or the key **ENTER** [5] to activate it. Table 4 shows the different options for the sound mode.

Type	Function	Band
4.50	Sound carrier 4.5 MHz above the picture carrier	Terrestrial
5.50	Sound carrier 5.5 MHz above the picture carrier	Terrestrial
5.74	Selects the second carrier in DUAL or STEREO transmissions, at 5.74 MHz of the picture carrier	Terrestrial
5.80	Sound carrier 5.8 MHz above the picture carrier	Satellite
6.00	Sound carrier 6.0 MHz above the picture carrier	Terrestrial
6.50	Sound carrier 6.5 MHz above the picture carrier	Terrestrial Satellite
6.65	Sound carrier 6.65 MHz above the picture carrier	Satellite
7.02	Sound carrier 7.02 MHz above the picture carrier	Satellite
NTUN	Continuous tuning (4.00 - 9.00 MHz) with narrow sound detection filter (110 kHz)	Terrestrial Satellite
BTUN	Continuous tuning (4.00 - 9.00 MHz) with broad sound detection filter (240 kHz)	Terrestrial Satellite
NICA	NICAM decoding	Terrestrial
AM	AM demodulation	Terrestrial
FM	FM demodulation	Terrestrial
LV	Tone whose frequency varies with the signal level	Terrestrial Satellite
OFF	Suppresses the sound	Terrestrial Satellite

Table 4.- Sound modes.

When you select the **NTUN** (continuous tuning using a narrow detection filter) and **BTUN** (continuous tuning using a broad detection filter) options the screen displays a window showing the **frequency deviation of the sound carrier**, this is variable between **4.00 MHz** and **9.00 MHz**. To define it press keys ⇧ ⇩ [6] to select the desired frequency deviation and press key **ENTER** [5] to validate.

When the **LV** function is selected, the speaker of the **MTD 120** permits a tone whose frequency depends on the level of the signal received. This is very useful when installing antennas, since the user can locate the peak signal without having to look continually at the monitor of the level meter.

When the **NICAM** option is selected, it is possible to measure the Bit Error Rate of the modulation. To obtain this measurement, from the **TV** operating mode, level measurement, press key **MONITOR** [1] in order to activate the mode of maximum measurement information displayed on the screen (name assigned to memory, power supply to external units, sound, colour system, TV standard, level and frequency/channel). In the position relative to the type of **Sound** will appear the information about the type of NICAM according to:

Sound: Type + Error

Type = NICAM type:

"**- -**": no NICAM is detected

"**du**": dual NICAM

"**st**": stereo NICAM

"**mo**": mono NICAM

Error = indication of the bit error rate:

"**E ⇩**": error rate < 1e-5

"**E5**": 1e-5 < error rate < 1e-4

"**E4**": 1e-4 < error rate < 1e-3

"**E3**": 1e-3 < error rate < 2.7 e-3

"**E ⇧**": error rate > 2.7 e-3

Therefore, for example, the indication **Sound: duE ⇩** has to be interpreted as NICAM sound is selected, the detected NICAM is dual and

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the error rate is below **1 e-5**.

4.12.- Measurement Configuration Memories

To facilitate measurement, the **MTD 120** is able to store up to 99 configurations in an internal memory. In this way, it is possible to select the most common transmissions in a work area with their corresponding configurations quickly and easily.

The following parameters are stored in each configuration: the name assigned to the configuration, frequency or channel number, TV system, type of measurement, external units supply voltage (VLNB), measurement units and sound parameters.

The different measuring configurations can be retrieved with the **Data logger** function, in order to conduct different data acquisitions in a completely automatic way and store them in the memory for later print-out or processing (see paragraph '4.9.2.4 Data logger function').

4.12.1.- Storing a Measurement Configuration (STORE)

The process of storing a measurement configuration is the following:

1. Select the configuration you want on the **MTD 120** (freq./channel, band, etc.).
2. Press key **MEMORY** [25] until the monitor displays the **STORE** screen. Check the configuration parameters. Then press keys ⇧ ⇩ [6], to select the memory number that you wish to store the configuration in (from 1 to 99). This number corresponds to the column headings of the Data Logger function.

   If a configuration is stored in a memory location already containing information, that data will be lost.
3. (Optional) If you wish to assign a name to a memory position press key **SHIFT** [31], the first character of the name will blink, press keys ⇧ ⇩ [6] and the different characters will appear in the first position of the configuration name. When you have chosen the first character press key **ENTER** [5], to automatically move on to the second character. Repeat the process for a maximum of four characters.

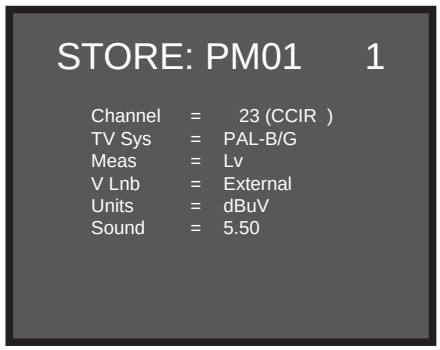

Figure 22.- STORE screen, storing a measuring configuration.

4. Finally, press key **MEMORY** [25] or the key **ENTER** [5] and the configuration will be stored. If any other key is pressed, an error will be indicated and the memory will not be updated.

4.12.2.- Retrieving a Configuration (RECALL)

Press key **MEMORY** [25]. The screen **RECALL** will appear on the monitor which shows the different parameters of each measuring configuration stored. Pressing keys ⇧ ⇩ [6], select the configuration to be retrieved (a number between 1 and 99).

Pressing the key **MEMORY** [25] again or the key **ENTER** [5] will retrieve the configuration.

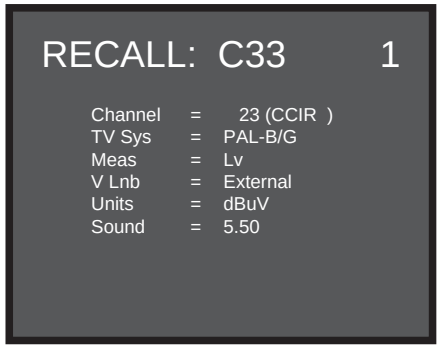

Figure 23.- RECALL screen, retrieving a measurement configuration.

4.13.- Direct Access to Functions

Keys **FA** [28] and **FB** [29] give direct access to any of the functions on the TV and Spectrum Analyser mode functions menus. To establish a relationship between the direct access key and a function, access the functions menu, select the function you wish to access directly and press key **FA** [28] or **FB** [29]. From then on when you press key **FA** [28] or **FB** [29] the function will be accessed directly.

4.14.- Printing Measurements and Memories

By connecting the instrument to a serial printer it is possible to obtain a printed report of a sequence of measurements just at the moment they are taken, or later, if they are recorded with the **Data logger** function. This enables the user to keep a file about the state of the system and provide the documents related to the level measurements for analysis purposes.

The installation process consists of simply using the data transfer cable to connect the printer to the RS-232C connector [37] on the **MTD 120** (see section '4.14.1 Handshake and control lines'). Switch off the power to both instruments before connecting.

To print measurements select the **Data logger** function on the functions menu (see section '4.9.2.4 Data Logger function'), access the configuration menu, activate the print field (Print: On) and switch on the printer. From now on the printing process is equivalent to taking measurements.

The following figure shows an example of printing two activated columns (memories 1 PM01 and 2 PM02) and two activated rows (test points 1 and 2).

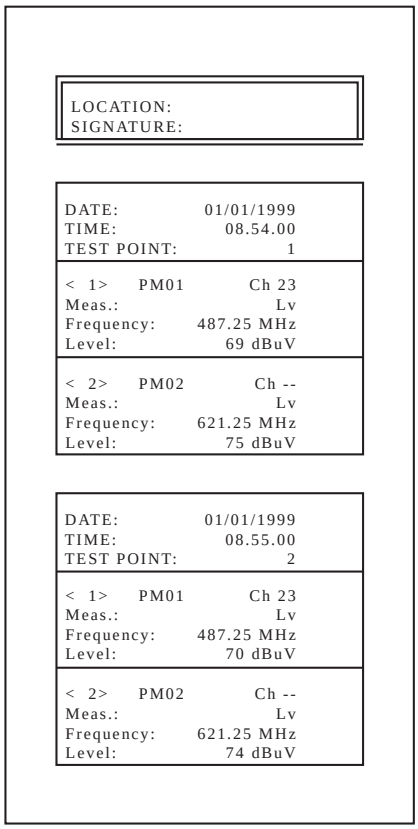

Figure 24.- Printing measurements.

4.14.1.- Handshake and Control Lines

Next is described the handshake and control lines used by the **MTD 120**:

- The following parameters are used for printing through the serial port:

Rate:	**19.200 bauds**
Data bits:	**8 bits**
Parity:	**No**
Stop bits:	**1**

- The control lines used are:

- DATA TRANSMIT (pin 3 **MTD 120**): To send data to the printer.
- CLEAR TO SEND (pin 8 **MTD 120**): Data transfer control. Data are sent only when this line is active.
- DATA TERMINAL READY (pin 4 **MTD 120**): This line is permanently active in order to indicate the establishment of the communication.

Connections

The cable between the **MTD 120** and the printer must have the following connections:

PC CONNECTOR Type D-25, female			**LEVEL METER CONNECTOR** Type D-9, female
SHIELD GROUND	1		
DATA TRANSMIT	2	→	2 DATA RECEIVE
DATA RECEIVE	3	←	3 DATA TRANSMIT
REQUEST TO SEND	4	→	1 CARRIER DETECT
CTS	5	←	4 DATA TERM. READY
DATA SET READY	6	←	
GROUND	7	—	5 GROUND
CARRIER DETECT	8	←	7 REQUEST TO SEND
DATA TERMINAL READY	20	→	6 DATA SEND READY
		→	8 CLEAR TO SEND
RING INDICATOR	22	—	9 RING INDICATOR

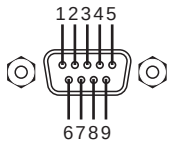

Figure 25.- Connector RS-232C **MTD 120**. Pins numbering.

5.- BER MEASUREMENT OF QPSK & QAM MODULATED SIGNALS

5.1.- Description

By means of the options BER measurement for DVB-Satellite (QPSK modulation), DVB-Cable signals (QAM modulation) and DVB-Terrestrial (COFDM modulation), it is possible to make Bit Error Rate measurements on digital signals. Besides, these options incorporate the **DCI function** (**DVB Channels Identifier**) which provides information on the tuned channel, in this way it is possible to identify it with total certainty with no need to decode the digital signal.

5.2.- BER measurement mode selection

To select the BER measurement mode:

1) Select the **TV** operating mode. If present operating mode is the spectrum analyser mode press key **SPECT** [21].

2) Select the terrestrial band for the measurement of QAM or COFDM modulated signals or the satellite band for the measurement of QPSK modulated signals.

QAM signals	47 MHz to 862 MHz
QPSK signals	950 MHz to 2150 MHz
COFDM signals	470 to 862 MHz

3) Select the **DIGITAL** operating mode by means of the key **A/D** [20].

4) Select the **BER** measurement mode: to do this press key **LEVEL** [22], press keys ⇧ ⇩ [6] to select the BER measuring mode, next, to activate it press key **ENTER** [5] or key **LEVEL** [22].

5.3.- QAM modulation

Before to measure the BER it is necessary to define some parameters concerning the digital signal, which are described next. To see its present value or to modify it, being in the BER measuring screen, press key **ENTER** [5], a multiple-choice menu showing the functions relative to the BER measurement will appear on the screen:

1) **Modulations**

It defines the modulation type. When selecting this function and pressing key **ENTER** [5], a multiple-choice menu will appear on the screen, this menu permits to choose one of the following modulations: **16, 32, 64, 128** and **256**.

2) **Symbol Rate**

When selecting this function and pressing key **ENTER** [5], a multiple-choice menu will appear on the screen, this menu permits to choose one of the following values: **6875, 6111, 5000, 4443, 1528, 1500, 1408, 1333, 1266, 1000 kbauds**, or well to define any other value by means of the **Other** option.

When selecting the **Other** option, a screen titled **QAM SYMBOL RATE** will appear, this screen shows present Symbol Rate value, to modify it press key **SHIFT** [31], enter the new value (four figures) and finally press key **ENTER** [5] to activate it.

3) **Spectral Inv.**

If necessary, activate the Spectral inversion. If the spectral inversion is not correctly selected, reception will not be correct.

4) **Attenuator**

It permits to select attenuation between 0 and 30 dB. It is advisable to activate the 30 dB attenuator under that measurement conditions where the signal level is near to the maximum input level (approximately starting from 20 dB under the maximum level) and it is possible that the tuner becomes saturated. Under no-saturation conditions, when increasing the attenuation value the BER measure must to maintain or to increase (insufficient signal level) but never to decrease.

Once you have defined the QAM signal parameters, it will be possible to measure the BER.

When the **BER** measuring mode is selected, the monitor will show a picture like the following:

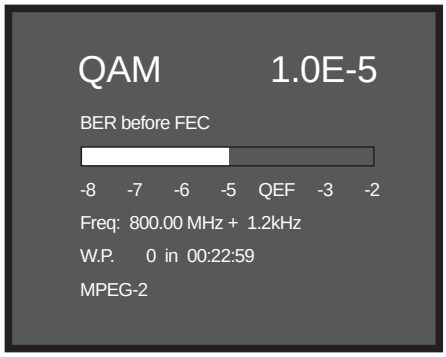

Figure 26.- BER measuring screen for QAM modulated signals.

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First of all it is shown the **BER before FEC** (Forward Error Correction).

In a digital reception system for cable signals, after the QAM decoder an error correction method called **Reed-Solomon** is applied (see figure 27). Obviously, the error rate after the corrector is lower to the error rate at the QAM decoder output. This is the reason because this screen provides the BER measurement before FEC (Forward Error Correction) and the number of non correctable errors (**W.P**., Wrong Packets) received after Reed-Solomon in the measuring time.

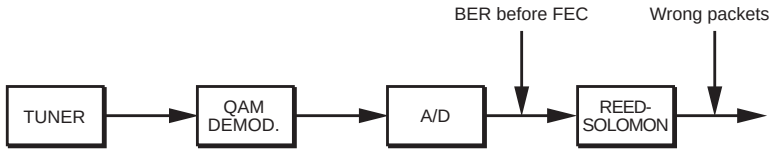


Figure 27.- Digital reception system via cable.

The BER measurement is provided in scientific notation (i.e. 1.0 E-5 means $1.0x10^{-5}$ that is to say one wrong bit of every 100,000) and through an analogue bar (as its length is smaller the signal quality will be better). The analogue representation is done on a logarithmic scale (not linear).

With the aim to have a reference about the signal quality, it is considered that a system has a good quality when it decodes less than one non-correctable error for every transmission hour. This border is known as **QEF** (**Quasi-Error-Free**) and it corresponds approximately to a BER before FEC of **2.0E-4 BER** ($2.0x10^{-4}$, that is to say two incorrect bits of every 10,000). This value is marked on the measurement bar of the BER and therefore, BER for acceptable signals must be at the **left side** of this mark.

Below the BER analogue bar it is shown the tuned frequency (or channel) and the frequency deviation in kHz between the tuned frequency and the one which optimizes the BER (i.e. 800.00 MHz + 1.2 kHz).

In the next line it is shown the number of non corrigible packets received '**wrong packets**' (up to a maximum of 126) in the time detailed on its right. A packet is considered wrong when one, at least, non corrigible bit is detected. To reset this measurement just modify the measurement conditions: for example change the tuned frequency.

Finally it is shown a status line which displays information about the detected signal. The possible messages that can appear and its meaning are shown in the following list. The messages are exposed from less to more fulfilment of the MPEG-2 standard:

No signal received

Any signal has been detected.

Signal received

A signal is detected but it can not be decoded.

Carrier recovered

A digital carrier has been detected but it can not be decoded.

MPEG-2

Correct detection of a MPEG-2 signal. The BER is showed.

In case of detecting a DVB signal, message **MPEG-2 DVB-C** will appear and the **DVB Channel Identifier** function will be autoatically activated. See section 5.4.1 **DVB Channel Identifier**.

IMPORTANT REMARK

DVB-C channels tuning may require an adjusting process. It is recommended to follow next procedure:

*1.- From the **spectrum analyser mode**, tune the channel at its central frequency.*

*2.- Switch to **TV mode**, **BER** measuring mode.*

*3.- If in the lower line of the screen does not appear **MPEG-2** message (and consequently BER is unacceptable), by pressing keys ⇧ ⇩ [6] deviate the tuning frequency until **MPEG-2** message appears. Finally tune channel again to minimize the **frequency deviation which optimizes the BER** and therefore minimize the BER.*

*If it is not possible to detect any MPEG-2 channel, make sure that digital signal parameters are correctly defined and if signal level is too low, check that the 30 dB attenuator is not activated (**Attenuator 0 dB**).*

5.4.- QPSK modulation

Before to measure the BER it is necessary to define some parameters concerning the digital signal, which are described next. To see its present value or to modify it, being in the BER measuring screen, press key **ENTER** [5], a multiple-choice menu showing the functions relative to the BER measurement will appear:

1) **Code Rate**

Also known as Viterbi ratio. It defines the ratio between the number of data bits and actual transmission bits (the difference corresponds to the control bits for error detection and correction). It permits to choose between **1/2, 2/3, 3/4, 4/5, 5/6, 6/7, 7/8, 8/9** and **Auto**. If **Code Rate** parameter is not known it is possible to assign the **Auto** option.

2) **Symbol Rate**

It is possible to choose between the following values: **30000, 27500, 22000, 20000, 19995, 6110, 6000, 5998, 5632, 5062, 4340, 4000** kbauds, or well to define any other value (**Other**). When selecting the **Other** option, a screen titled Q**PSK SYMBOL RATE** will appear. This screen shows present value, to modify it press key **SHIFT** [31] and enter the new value through the keyboard. The unit accepts any number with **5 figures** between **2000** and **35000 kbauds** (fifth figure acts as validation). For example, to select a symbol rate of 8200 kbauds it must be entered: 08200.

3) **Spectral Inv.**

Finally, if necessary, activate the Spectral inversion. The **Auto** mode permits to automate this selection except for the following **Code Rate: 4/5, 5/6, 6/7** and **8/9**. If the spectral inversion is not correctly selected, reception will not be correct.

4) **Attenuator**

It permits to select attenuation between 0 and 30 dB. It is advisable to activate the 30 dB attenuator under that measurement conditions where the signal level is near to the maximum input level (approximately starting from 20 dB under the maximum level) and it is possible that the tuner becomes saturated. Under no-saturation conditions, when increasing the attenuation value the BER measure must to maintain or to increase (insufficient signal level) but never to decrease.

Once you have defined the QPSK signal parameters, it will be possible to measure the BER.

When the **BER** measuring mode is selected, the monitor will show a picture like the following:

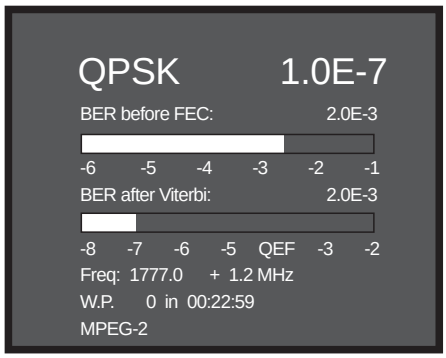


Figure 28.- BER measuring screen for QPSK modulated signals.

Two BER measurements are shown:

1) **BER before FEC** (Forward Error Corrections)

2) **BER after Viterbi**

In a digital reception system for satellite signals, after the QPSK decoder two different correction methods are applied (see figure 29). Obviously, each time we apply an error corrector to a digital signal, the error rate changes, therefore if we measure in a digital satellite television system, for example, the error rate at the output of the QPSK demodulator, at the output of the Viterbi decoder, and at the output of the Reed-Solomon decoder, we obtain nothing more than different error rates. This is the reason because the BER measurement is provided before FEC, after Viterbi and the number of non correctable errors (**W.P.** - wrong packets-) received after Reed-Solomon for the measuring time.

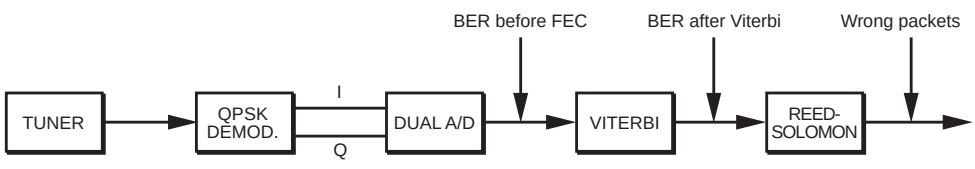


Figure 29.- Digital reception system via satellite.

The BER measurement is provided in scientific notation (i.e. 2.0 E-3 means $2.0x10^{-3}$, that is to say two incorrect bits of every 1,000) and through an analogue bar (as its length is smaller the signal quality will be better). The analogue representation is done on a logarithmic scale (not linear).

With the aim to have a reference about the signal quality, it is considered that a system has a good quality when it decodes less than one non-correctable error for every transmission hour. This border is known as **QEF** (**Quasi-Error-Free**) and it corresponds approximately to a BER after Viterbi of **2.0E-4 BER** ($2.0x10^{-4}$). This value is marked on the measurement bar of the BER after Viterbi and therefore, BER for acceptable signals must be at the **left side** of this mark.

Next it is shown the tuning frequency and the frequency deviation in MHz between the tuned frequency and the one which optimizes the BER (i.e. Freq: 1777.0 +1.2 MHz).

Next it is shown the number of non corrigible packets received **W.P.** -wrong packets- (up to a maximum of 126) in the time detailed on its right. A packet is considered wrong when a bit is received incorrectly. To reset this measurement just modify the measurement conditions: for example change the tuning frequency.

Finally it is shown a status line with information about the detected signal. The possible messages that can appear and its meaning are shown in the following list. The messages are exposed from less to more fulfilment of the MPEG-2 standard:

No signal received

Any signal has been detected.

Signal received

A signal is detected but it can not be decoded.

Carrier recovered

A digital carrier has been detected but it can not be decoded.

Viterbi synchronized

A digital carrier has been detected and the Viterbi algorithm is synchronized, but too many frames arrive with non correctable errors. It is not possible to quantify the BER.

MPEG-2

Correct detection of a MPEG-2 signal.

In case of detecting a DVB signal, message **MPEG-2 DVB-S** will appear and the **DVB Channel Identifier** function will be automatically activated. See section 5.4.1 **DVB Channel Identifier**.

IMPORTANT REMARK

DVB-S channels tuning may require an adjusting process. It is recommended to follow next procedure:

*1.- From the **spectrum analyser mode**, tune the channel at its central frequency.*

*2.- Switch to **TV mode**, **BER** measuring mode.*

*3.- If in the lower line of the screen does not appear **MPEG-2** message (and consequently BER is unacceptable), by pressing keys ⇧ ⇩ [6] deviate the tuning frequency until **MPEG-2** message appears. Finally tune again channel to minimize the **frequency deviation which optimizes the BER** and therefore minimize the BER.*

*If it is not possible to detect any MPEG-2 channel, make sure that digital signal parameters are correctly defined and if signal level is too low, check that the 30 dB attenuator is not activated (**Attenuator 0 dB**).*

5.5.- COFDM modulation

Before to measure the BER it is necessary to define some parameters concerning the digital signal, which are described next. To see its present value or to modify it, being in the BER measuring screen, press the **ENTER** [5] key, a multiple-choice menu showing the functions relative to the BER measurement will appear. The parameters that must be defined by the user are the following:

1) **Carriers**

It defines the number of modulation carriers between 2k and 8k. To modify its value, place the marker over the Carriers field by pressing keys ⇧ ⇩ [6] and then press **ENTER** [5] key: a menu will appear on the screen. With keys ⇧ ⇩ [6] select the desired value for the Carriers parameter and finally press **ENTER** [5] key again to validate.

2) **Guard interval**

The Guard Interval parameter corresponds to the time between symbols, its purpose is to permit a correct detection in multi-path situations. This parameter is defined according to the symbol length: 1/4, 1/8, 1/16, 1/32. To modify its value, press keys ⇧ ⇩ [6] and place the marker over the Guard Interval field and then press **ENTER** [5] key: a menu with the available values will appear. Then pressing keys ⇧ ⇩ [6] select the desired value and finally press **ENTER** [5] key to validate.

3) **Attenuator**

It permits to select attenuation between 0 and 30 dB. It is advisable to activate the 30 dB attenuator under that measurement conditions where the signal level is near to the maximum input level (approximately starting from 20 dB under the maximum level) and it is possible that the tuner becomes saturated. Under no-saturation conditions, when increasing the attenuation value the BER measure must to maintain or to increase (insufficient signal level) but never to decrease.

This configuration menu shows, besides the user definable COFDM signal parameters, the value of the rest of COFDM signal parameters detected automatically:

Code Rate	Also known as Viterbi ratio, defines the ratio between the data bits number and the total number of bits transmitted (the difference corresponds to the number of control bits for the error detection and recovery).
Modulations	Carriers modulation. It also defines the system noise immunity. (QPSK, 16-QAM and 64-QAM).
Spectral Inv.	Defines the state of the spectral inversion.
Hierarchy	The DVB-T norm contemplates the possibility to make a DTT transmission with hierarchical levels, it is to say a simultaneous transmission of the same program with different image qualities and noise protection levels, in order the receiver decodes the signal in the best conditions.

Once you have defined the COFDM signal parameters, it will be possible to measure the BER. When the **BER** measuring mode is selected, the monitor will show a picture like the following:

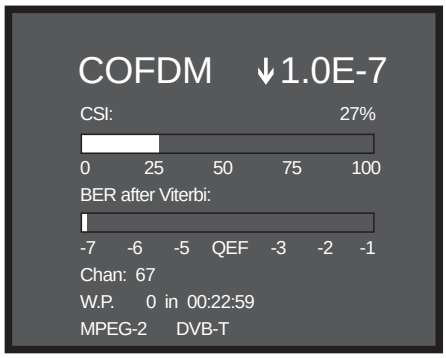


Figure 30.- COFDM signals BER measuring screen.

Two measures are shown:

1) **CSI**: Channel status information

2) **BER after Viterbi**

The **CSI** measure (Channel Status Information) is a qualitative measure about channel state, between 0 and 100%. The optimum value corresponds to 0%. This measure permits to look for the best situation even in those measuring conditions where the measured BER is best than the minimum readout (in this way, in the example of the previous figure, the measured BER is lower that the minimum readout, $1.0x10^{-7}$, but the CSI measurement, 27%, still can be improved).

Next it is shown the **BER after Viterbi** measurement both in numeric and graphic bar format.

In a reception system of terrestrial digital signal, after the COFDM decoder two error correction methods are applied. Obviously, each time we apply an error corrector to the digital signal, the error rate changes, therefore if we measure the error rate at the output of the COFDM demodulator, at the output of the Viterbi decoder, and at the output of the Reed-Solomon decoder, we obtain nothing more than different error rates. This is the reason because of the QPSK-COFDM option provide the **BER after Viterbi** and the number of **Wrong packets** received after Reed- Solomon.

ENGLISH

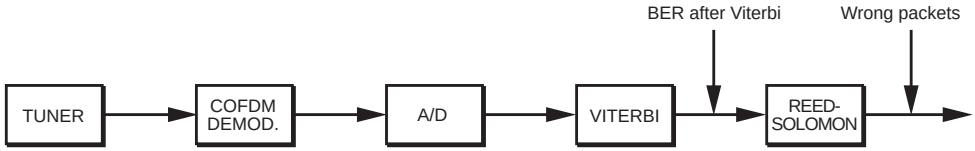


Figure 31.- COFDM reception system.

The BER measurement is provided in scientific notation (i.e. 3.1 E-7 means $3.1x10^{-7}$, that is to say 3.1 wrong bits of each 10000000) and through a graphic bar (as its length is smaller the signal quality will be better). The analogue representation is done on a logarithmic scale (not linear), that is to say, the bar divisions correspond to the exponent of the measurement.

With the aim to have a reference about the signal quality, it is considered that a system has a good quality when it decodes less than one non-correctable error for every transmission hour. This border is known as **QEF** (**QUASI-ERROR-FREE**) and it corresponds approximately to a BER after Viterbi of **2.0E-4 BER** ($2.0x10^{-4}$, that is to say 2 wrong bits of each 10000). This value is marked on the measurement bar of the BER and therefore, BER for acceptable signals must be at the **left** side of this mark.

In the lower line of the screen it appears the **W. P.** counter (Wrong Packets counter). This counter shows the number of wrong packets received after Reed-Solomon during the measuring time. This counter is automatically activated when the unit detects an MPEG-2 signal.

If at any time, the received signal stops to satisfy the requirements of the MPEG-2 standard, this counter will deactivate, that is to say it will keep the number of wrong packets received and the measuring time, later, if an MPEG-2 signal is received again, it will activate with no reset.

When during any measuring time interval the counter has been deactivated, in other words the signal has not satisfied the MPEG-2 requirements, the presentation of this counter will alternate with another counter titled **FAIL**. This second counter shows the time that the detected signal has not fulfilled the MPEG-2 standard requirements (12 seconds in the example of the following figure) and the number of signal cuts (2 in the example of the following figure). To reset the counter it is necessary to change any of the detection parameters, for example tune again the signal or push twice the **LEVEL** [22] key.

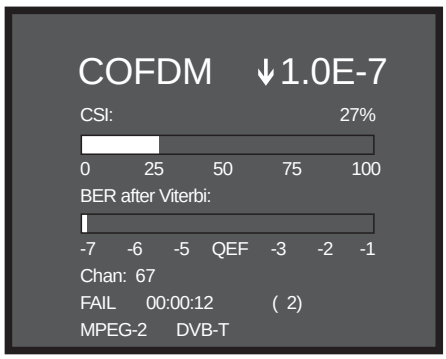


Figure 32.- Signalling two MPEG-2 signal cuts with a total length of 12 seconds.

Finally it is shown a status line with information about the detected signal. The possible messages that can appear and its meaning are showing the following list. The messages are exposed from less to more fulfilment of the MPEG-2 standard:

No signal received

No signal has been detected.

Timing recovered

Only it is possible to recuperate the symbol time.

AFC in lock

The system automatic frequency control can identify and lock a digital transmission (DTT) but its parameters can not be obtained. It can be due to a transitory situation previous to the TPS identification (Transmission Parameter Signalling) or well to a DTT transmission with an insufficient C/N ratio.

TPS in lock

The TPS (Transmission Parameter Signalling) are decoded. The TPS are carriers (17 in the 2k system and 68 in the 8k system) modulated in DBPSK, containing information related to the transmission, modulation and codification: Modulation type (QPSK, 16-QAM, 64-QAM), Hierarchy, Guard Interval, Viterbi Code Rate, Transmission mode (2k or 8k) and Number of the received frame.

MPEG-2

Correct detection of a MPEG-2 signal.

In case of detecting a DVB signal, message **MPEG-2 DVB-T** will appear and the **DVB Channel Identifier** function will be automatically activated. See section 5.6. **DVB Channel Identifier**.

5.6.- DVB Channels Identifier: DCI function

This function permits to identify DVB channels with no need to have a digital signal decoder which permits to see transmitted TV channels.

The **DVB** group recommends to digital TV service operators the codification on the **Transport Stream** of some particular fields containing data information. The **Transport Stream** is a sequence of packets, of constant length, which carry video or audio information or data.

Data packets can be grouped to constitute TABLES, some of these tables content information defined by the network operator and which show the type of service that is being supplied to the users. Among the different data defined in these tables, the most frequently used data for channel identification purposes are:

Network It contents the name given to the set of all the Transport Stream managed inside the same communication channel.

Bouquet It contents the name given to the set of all the services commercialized as one entity.

Service It contents the names of services that, under the control of one operator, can be shown at each moment on the Transport Stream, as a function of current programming.

In case the operator includes this information, the three fields are not transmitted at the same time but they appear alternatively in different packets. Besides, the cadence of presentation of each one of these packets may vary from one operator to another.

When tuning a DVB compatible transponder, the **DCI function** (**DVB Channels Identifier**) detects those data packets including service information relative to these three fields and shows on the lower line on the screen the information contained in them automatically.

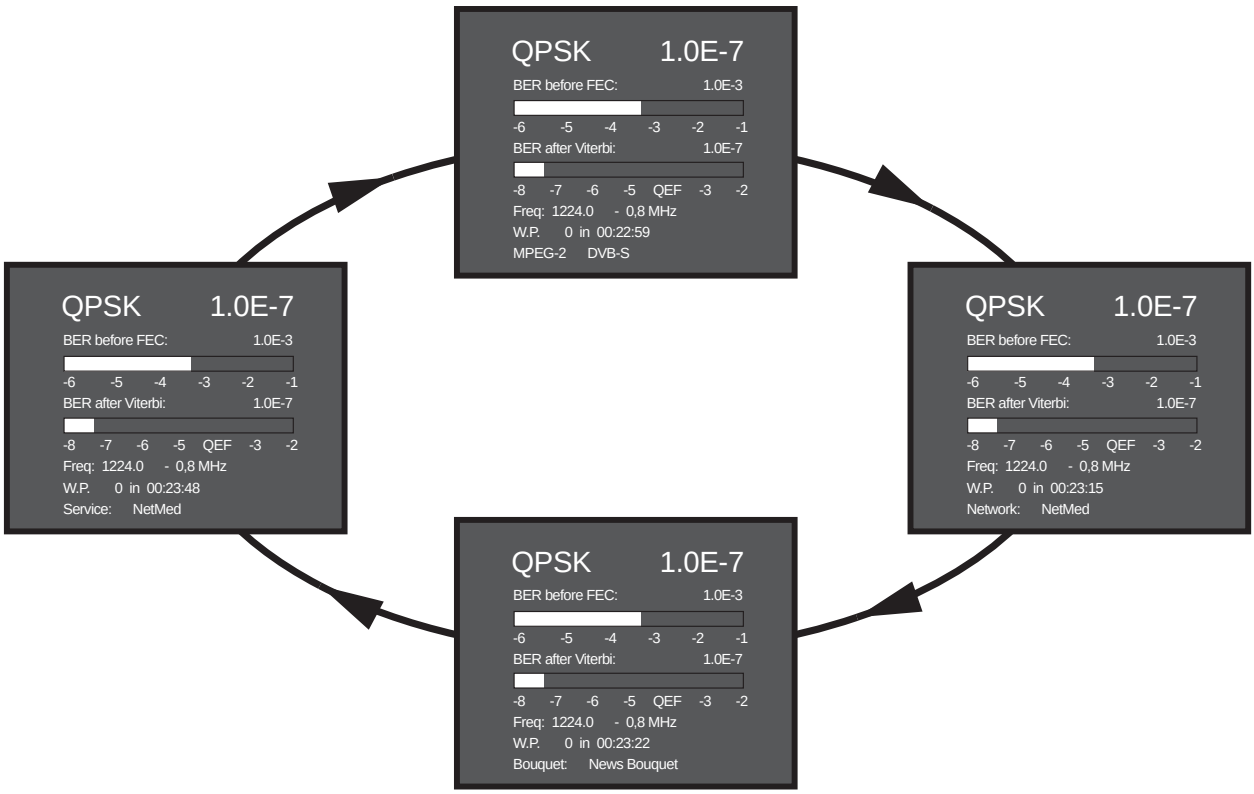

QPSK 1.0E-7
BER before FEC: 1.0E-3
-6 -5 -4 -3 -2 -1
BER after Viterbi: 1.0E-7
-8 -7 -6 -5 QEF -3 -2
Freq: 1224.0 - 0,8 MHz
W.P. 0 in 00:22:59
MPEG-2 DVB-S
QPSK 1.0E-7
BER before FEC: 1.0E-3
-6 -5 -4 -3 -2 -1
BER after Viterbi: 1.0E-7
-8 -7 -6 -5 QEF -3 -2
Freq: 1224.0 - 0,8 MHz
W.P. 0 in 00:23:48
Service: NetMed
QPSK 1.0E-7
BER before FEC: 1.0E-3
-6 -5 -4 -3 -2 -1
BER after Viterbi: 1.0E-7
-8 -7 -6 -5 QEF -3 -2
Freq: 1224.0 - 0,8 MHz
W.P. 0 in 00:23:15
Network: NetMed
QPSK 1.0E-7
BER before FEC: 1.0E-3
-6 -5 -4 -3 -2 -1
BER after Viterbi: 1.0E-7
-8 -7 -6 -5 QEF -3 -2
Freq: 1224.0 - 0,8 MHz
W.P. 0 in 00:23:22
Bouquet: News Bouquet

Figure 33.- DCI function. In this example the information coded by the operator on the Service and Network fields is the same.

The information that appears in the **Network**, **Bouquet** and **Service** fields is responsibility of the Operator in charge of the tuned transponder. The MTD 120 only decodes this information, if it is present, and shows it on the screen.

6.- DESCRIPTION OF THE INPUTS AND OUTPUTS

6.1.- RF input

The RF input is through the RF ⊖ [35] connector on the side panel. The peak signal level should never exceed 130 dBµV.

6.2.- RS-232C serial port

The **MTD 120** incorporates an RS-232C serial port for data exchange with a PC, a serial printer or to other devices. The signals in this connector are described in Table 5.

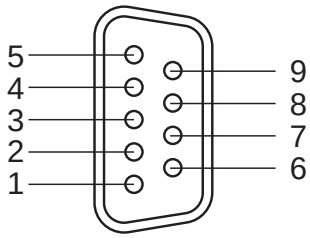


Figure 34.- RS-232C connector. External view.

PIN No.	SIGNAL	CHARACTERISTICS
1	Carrier Detect	(not connected)
2	Data Request (RxD)	
3	Data Transmit (TxD)	
4	Data Transmission Ready (DTR)	Fixed at +12 V
5	Ground (GND)	
6	Data Send Ready (DSR)	(not connected)
7	Request To Send (RTS)	
8	Clear To Send (CTS)	
9	Ring Indicator	(not connected)

Table 5.- Description of the RS-232C connector.

ENGLISH

6.3.- Scart (DIN EN 50049)

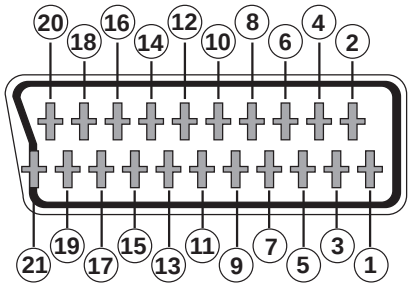


Figure 35.- Scart socket (external view).

Also known as PERITEL connector (in conformity with standard NF-C92250). The signals in this connector are the following:

PIN number	SIGNAL	CHARACT.	PIN number	SIGNAL	CHARACT.
1	Right channel audio output		12	Digital bus interface	(not connected)
2	Right channel audio input		13	Red grounding (R)	
3	Left channel audio output		14	Digital bus reserved	(not connected)
4	Audio grounding		15	Red output (R)	
5	Blue grounding (B)		16	Blanked signal	(not connected)
6	Left channel audio input		17	Composite video grounding	
7	Blue output (B)		18	Blanked return	(not connected)
8	Switching voltage		19	Composite video output	
9	Green grounding (G)		20	Video input	
10	Digital bus interface	(not connected)	21	Connector shield grounding	
11	Green output (G)				

Table 6.- Description of the Scart.

7.- MAINTENANCE

7.1.- Considerations about the Screen (only ref. 4202)

This paragraph offers key considerations regarding the use of the colour screen, taken from the specifications of the manufacturer.

In the LCD display, the user may find pixels that do not light up or pixels that are permanently lit. This should not be regarded as a defect in the LCD. In accordance with the manufacturer quality standard, 9 pixels with these characteristics are considered admissible.

Pixels which are not detected when the distance from the surface of the LCD screen to the human eye is greater than 35 cm, with a viewing angle of 90º between the eye and the screen should not be considered manufacturing defects either.

It is advisable a viewing angle of 15º in the 6.00 o'clock direction in order to obtain the optimum visualization of the screen. See following figure.

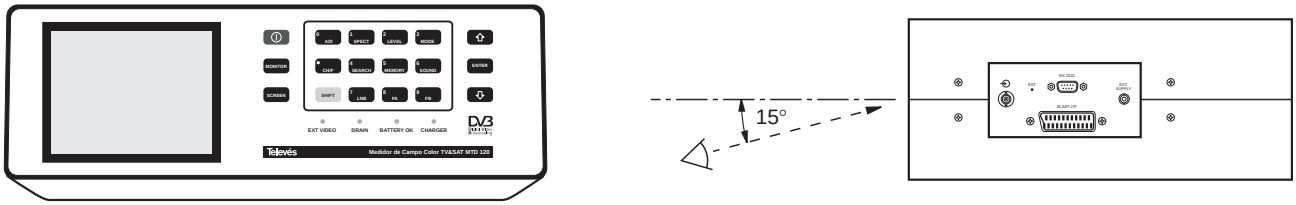


Figure 36.- Optimum viewing of the screen.

7.2.- Internal fuses which user cannot replace

The following fuses are found on the base board. Their location identifier and characteristics are the following:

F4 & F5	**5 A**	**F**	**63 V**	**SMD**
F3	**1 A**	**F**	**63 V**	**SMD**

7.3.- Replacing the Batteries

Batteries must be replaced whenever the capacity of the fully-charged batteries is noticeably diminished. To change the batteries, follow next procedure:

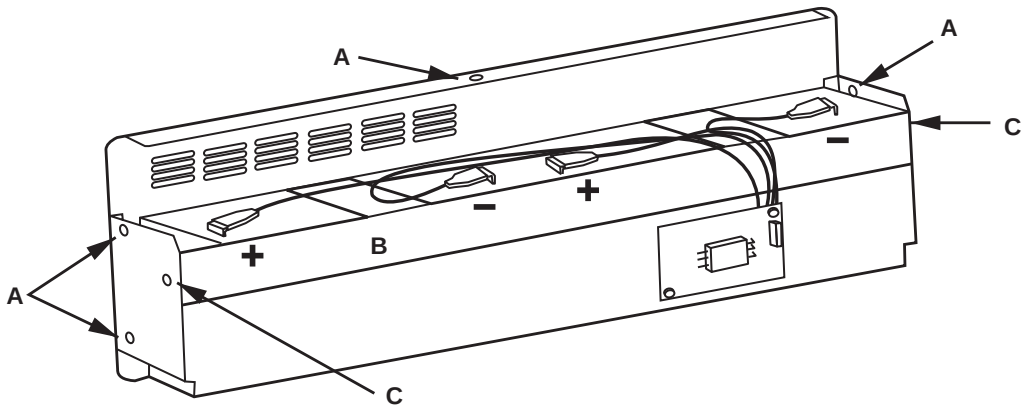


Figure 37.- Battery compartment.

- Remove the rear holster, if in place.
- The battery compartment is located in the rear panel of the instrument. Remove the 5 securing screws (**A**) (2 on each side and 1 at the bottom) shown in the previous figure (here the battery compartment is shown taken out and facing down). Rest the **MTD 120** on its rear panel and lift it to free the battery compartment.
- Remove the 2 side screws (**C**) securing the battery holder (**B**).
- Disconnect the battery terminals, remove the anti-humidity paper and replace the batteries with two new ones of the same type.

IMPORTANT

The maximum period of time that the instrument can remain disconnected from the batteries before loosing measurement configurations and stored data is 5 minutes.

- Replace the anti-humidity paper and connect the terminals to the new batteries. Remember to maintain the polarity of the terminals: red-positive, black-negative.

WARNING

Avoid any type of short circuit among the cables connected to the battery, since the resulting high current may cause serious damage to the instrument.

- Place and secure the battery holder (**B**) with the two screws (**C**).
- Insert the battery compartment into the back of the **MTD 120** and secure with the five screws (**A**).
- If you wish, replace the holster.

7.4.- Cleaning Recommendations

CAUTION

To clean the cover, take care the instrument is disconnected.
Do not use scented hydrocarbons or chlorized solvents.
Such products may attack the plastics used in the construction of the cover.

The cover should be cleaned by means of a light solution of detergent and water applied with a soft cloth.

Dry thoroughly before using the system again.

CAUTION

Do not use for the cleaning of the front panel and particularly the viewfinders, alcohol or its derivatives, these products can attack the mechanical properties of the materials and diminish their useful time of life.

APENDICE A .- Tablas Canal - Frecuencia
APPENDICE A: Tables Canal-Fréquence
APPENDIX A: Channel - Frequency tables

C C I R

Ch.	Freq.	Ch.	Freq.	Ch.	Freq.	Ch.	Freq.	Ch.	Freq.	Ch.	Freq.	Ch.	Freq.
2	48,25	7	189,25	S20	294,25	S35	415,25	29	535,25	44	655,25	59	775,25
3	55,25	8	196,25	S21	303,25	S36	423,25	30	543,25	45	663,25	60	783,25
4	62,25	9	203,25	S22	311,25	S37	431,25	31	551,25	46	671,25	61	791,25
S01	105,25	10	210,25	S23	319,25	S38	439,25	32	559,25	47	679,25	62	799,25
S02	112,25	11	217,25	S24	327,25	S39	447,25	33	567,25	48	687,25	63	807,25
S03	119,25	12	224,25	S25	335,25	S40	455,25	34	575,25	49	695,25	64	815,25
S04	126,25	S11	231,25	S26	343,25	S41	463,25	35	583,25	50	703,25	65	823,25
S05	133,25	S12	238,25	S27	351,25	21	471,25	36	591,25	51	711,25	66	831,25
S06	140,25	S13	245,25	S28	359,25	22	479,25	37	599,25	52	719,25	67	839,25
S07	147,25	S14	252,25	S29	367,25	23	487,25	38	607,25	53	727,25	68	847,25
S08	154,25	S15	259,25	S30	375,25	24	495,25	39	615,25	54	735,25	69	855,25
S09	161,25	S16	266,25	S31	383,25	25	503,25	40	623,25	55	743,25		
S10	168,25	S17	273,25	S32	391,25	26	511,25	41	631,25	56	751,25		
5	175,25	S18	280,25	S33	399,25	27	519,25	42	639,25	57	759,25		
6	182,25	S19	287,25	S34	407,25	28	527,25	43	647,25	58	767,25		

S T D L

Ch.	Freq.	Ch.	Freq.	Ch.	Freq.	Ch.	Freq.	Ch.	Freq.	Ch.	Freq.	Ch.	Freq.
FA	47,75	12	232	D09	399,25	31	551,25	42	639,25	53	727,25	64	815,25
FB	55,75	13	240	21	471,25	32	559,25	43	647,25	54	735,25	65	823,25
FC1	60,50	14	288	22	479,25	33	567,25	44	655,25	55	743,25	66	831,25
FC	63,75	D01	303,25	23	487,25	34	575,25	45	663,25	56	751,25	67	839,25
5	176	D02	315,25	24	495,25	35	583,25	46	671,25	57	759,25	68	847,25
6	184	D03	327,25	25	503,25	36	591,25	47	679,25	58	767,25	69	855,25
7	192	D04	339,25	26	511,25	37	599,25	48	687,25	59	775,25		
8	200	D05	351,25	27	519,25	38	607,25	49	695,25	60	783,25		
9	208	D06	363,25	28	527,25	39	615,25	50	703,25	61	791,25		
10	216	D07	375,25	29	535,25	40	623,25	51	711,25	62	799,25		
11	224	D08	387,25	30	543,25	41	631,25	52	719,25	63	807,25		

O I R T

Ch.	Freq.	Ch.	Freq.	Ch.	Freq.	Ch.	Freq.	Ch.	Freq.	Ch.	Freq.	Ch.	Freq.
1	49,75	8	191,25	S21	311,25	S36	431,25	31	551,25	46	671,25	61	791,25
2	59,25	9	199,25	S22	319,25	S37	439,25	32	559,25	47	679,25	62	799,25
3	77,25	10	207,25	S23	327,25	S38	447,25	33	567,25	48	687,25	63	807,25
4	85,25	11	215,25	S24	335,25	S39	455,25	34	575,25	49	695,25	64	815,25
5	93,25	12	223,25	S25	343,25	S40	463,25	35	583,25	50	703,25	65	823,25
SK1	111,25	SK11	231,25	S26	351,25	21	471,25	36	591,25	51	711,25	66	831,25
SK2	119,25	SK12	239,25	S27	359,25	22	479,25	37	599,25	52	719,25	67	839,25
SK3	127,25	SK13	247,25	S28	367,25	23	487,25	38	607,25	53	727,25	68	847,25
SK4	135,25	SK14	255,25	S29	375,25	24	495,25	39	615,25	54	735,25	69	855,25
SK5	143,25	SK15	263,25	S30	383,25	25	503,25	40	623,25	55	743,25		
SK6	151,25	SK16	271,25	S31	391,25	26	511,25	41	631,25	56	751,25		
SK7	159,25	SK17	279,25	S32	399,25	27	519,25	42	639,25	57	759,25		
SK8	167,25	SK18	287,25	S33	407,25	28	527,25	43	647,25	58	767,25		
6	175,25	S19	295,25	S34	415,25	29	535,25	44	655,25	59	775,25		
7	183,25	S20	303,25	S35	423,25	30	543,25	45	663,25	60	783,25		

F C C

Ch.	Freq.	Ch.	Freq.	Ch.	Freq.	Ch.	Freq.	Ch.	Freq.	Ch.	Freq.	Ch.	Freq.
A02	55,25	A13	211,25	24	531,25	35	597,25	46	663,25	57	729,25	68	795,25
A03	61,25	14	471,25	25	537,25	36	603,25	47	669,25	58	735,25	69	801,25
A04	67,25	15	477,25	26	543,25	37	609,25	48	675,25	59	741,25	70	807,25
A05	77,25	16	483,25	27	549,25	38	615,25	49	681,25	60	747,25	71	813,25
A06	83,25	17	489,25	28	555,25	39	621,25	50	687,25	61	753,25	72	819,25
A07	175,25	18	495,25	29	561,25	40	627,25	51	693,25	62	759,25	73	825,25
A08	181,25	19	501,25	30	567,25	41	633,25	52	699,25	63	765,25	74	831,25
A09	187,25	20	507,25	31	573,25	42	639,25	53	705,25	64	771,25	75	837,25
A10	193,25	21	513,25	32	579,25	43	645,25	54	711,25	65	777,25	76	843,25
A11	199,25	22	519,25	33	585,25	44	651,25	55	717,25	66	783,25	77	849,25
A12	205,25	23	525,25	34	591,25	45	657,25	56	723,25	67	789,25	78	855,25

ASTRA-HL

Ch.	Freq.	Ch.	Freq.	Ch.	Freq.	Ch.	Freq.	Ch.	Freq.	Ch.	Freq.	Ch.	Freq.
49	10714,25	59	10861,75	37	11023,25	47	11170,75	9	11332,25	19	11493.75	29	11641,25
51	10743,75	61	10891,25	39	11052,75	1	11214,25	11	11361,75	21	11523,25	31	11670,75
53	10773,25	63	10920,75	41	11082,25	3	11243,75	13	11391,25	23	11552,75		
55	10802,75	33	10964,25	43	11111,75	5	11273,25	15	11420,75	25	11582,25		
57	10832,25	35	10993,75	45	11141,25	7	11302,75	17	11464,25	27	11611,75		

ASTRA-VL

Ch.	Freq.	Ch.	Freq.	Ch.	Freq.	Ch.	Freq.	Ch.	Freq.	Ch.	Freq.	Ch.	Freq.
50	10729,00	60	10876,50	38	11038,00	48	11185,50	10	11347,00	20	11508,50	30	11656,00
52	10758,50	62	10906,00	40	11067,50	2	11229,00	12	11376,50	22	11538,00	32	11685,50
54	10788,00	64	10935,50	42	11097,00	4	11258,50	14	11406,00	24	11567,50		
56	10817,50	34	10979,00	44	11126,50	6	11288,00	16	11435,50	26	11597,00		
58	10847,00	36	11008,50	46	11156,00	8	11317,50	18	11479,00	28	11626,50		

ASTRA-HH

Ch.	Freq.	Ch.	Freq.	Ch.	Freq.	Ch.	Freq.	Ch.	Freq.	Ch.	Freq.	Ch.	Freq.
65	11720	73	11876	81	12032	89	12188	97	12344	105	12515	113	12633
67	11758	75	11914	83	12070	91	12226	99	12382	107	12545	115	12663
69	11798	77	11954	85	12110	93	12266	101	12422	109	12574	117	12692
71	11837	79	11992	87	12148	95	12304	103	12460	111	12604	119	12722

ASTRA-VH

Ch.	Freq.	Ch.	Freq.	Ch.	Freq.	Ch.	Freq.	Ch.	Freq.	Ch.	Freq.	Ch.	Freq.
66	11740	74	11895	82	12051	90	12207	98	12363	106	12522	114	12640
68	11778	76	11934	84	12090	92	12246	100	12402	108	12552	116	12670
70	11817	78	11973	86	12129	94	12285	102	12441	110	12581	118	12699
72	11856	80	12012	88	12168	96	12324	104	12480	112	12610	120	12728

EUT13-HL

Ch.	Freq.	Ch.	Freq.	Ch.	Freq.	Ch.	Freq.	Ch.	Freq.	Ch.	Freq.	Ch.	Freq.
111	10722	119	10892	125	11009	131b	11178	5	11304	11D	11413	153	11566
113	10775	121D	10914	127	11054	1D	11205	7	11348	11A	11431	155	11604
115	10815	121A	10933	129	11095	1A	11224	9D	11371	13	11474	157	11642
117	10853	123	10974	131	11148	3	11265	9A	11389	15	11516		

EUT13-VL

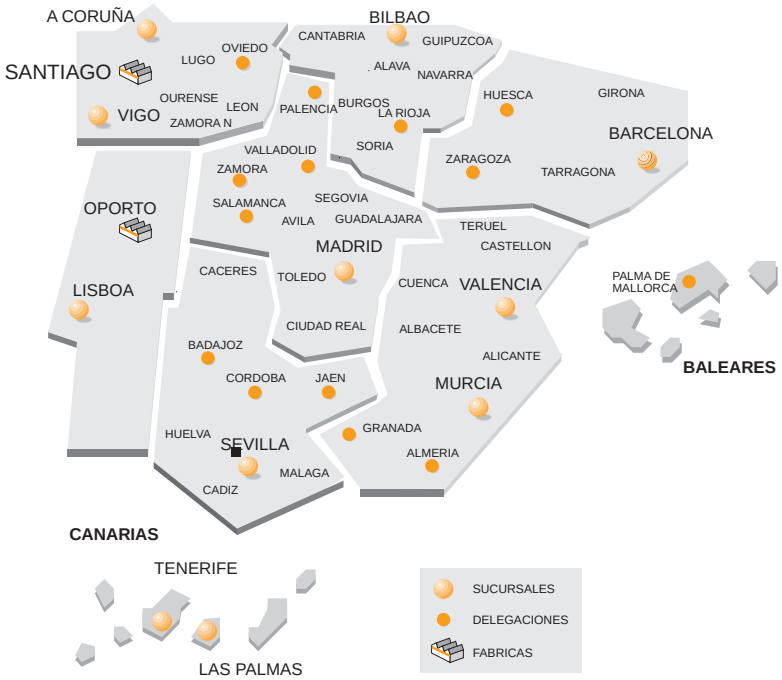
Ch.	Freq.	Ch.	Freq.	Ch.	Freq.	Ch.	Freq.	Ch.	Freq.	Ch.	Freq.	
110	10719	120	10911	130A	11113	4	11280	10A	11404	16	11531	
112	10758	122	10949	130D	11131	4b	11283	10D	11422	154	11585	
114	10796	124	10989	132A	11163	6A	11321	12A	11446	156	11623	
116	10834	126	11033	132D	11196	6D	11339	12D	11446,10	158	11662	
118	10873	128	11079	2	11241	8	11363	14	11492			

EUT13-HH

Ch.	Freq.	Ch.	Freq.	Ch.	Freq.	Ch.	Freq.	Ch.	Freq.	Ch.	Freq.	Ch.	Freq.
159	11681	59	11900	69	12092	77	12245	87	12437	93c	12583	101	12735
51	11745	61	11938	71	12130	79	12284	89	12476	93d	12590		
53	11785	63	11977	73	12168	81	12322	91	12539	95	12615		
55	11823	65	12015	75	12203	83	12360	93	12565	97	12654		
57	11862	67	12053	75b	12211	85	12399	93b	12573	99	12692		

EUT13-VH

Ch.	Freq.	Ch.	Freq.	Ch.	Freq.	Ch.	Freq.	Ch.	Freq.	Ch.	Freq.	Ch.	Freq.
50	11727	58	11881	66	12034	74	12188	82	12341	90	12520	98	12673
52	11766	60	11919	68	12073	76	12226	84	12380	92	12558	100	12713
54	11804	62	11958	70	12111	78	12265	86	12418	94	12597		
56	11843	64	11996	72	12149	80	12303	88	12460	96	12634		



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